FOUNDRY TRADE JOURNAL

Established 1902

Vol. 93 Thursday, October 9, 1952 No. 1884

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PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s., Abroad 45s. (Prepaid).

49 Wellington Street, London, W.C.2. 'Phone : Temple Bar 3951 (Private Branch Exchange) Grams : "Zacatecas, Rand, London"

Standardized Moulding Boxes

In January, 1948, we mooted for the second time the notion that it would be of benefit to the foundry industry if the essentials of moulding boxes could be standardized. We were supported in this by the Slough section of the London branch of the Institution of British Foundrymen and the Technical Council decided to investigate the problem. Some opposition was encountered, but under the enthusiastic leadership of Mr. John Blakiston a report was quickly produced. Instead of presenting this for discussion, the report became the basis for the production of a British Standards Institution Specification and after only two meetings has been issued as B.S. 1889:1952.

The objects of standardization are to reduce the number of box-part sizes with beneficial effects on storage room, and the provision of a known basis for designers of foundry plant and cast components. In the past, the sizes of boxes have more or less been decided upon so as to accommodate the product of the drawing board. Now the position is reversed and the designer has the chance of correlating his design to use standard moulding boxes. The value of second-hand boxes, if of standard dimensions, should also be increased. Perhaps the most important factor is that overseas countries will adopt this new British Standard. At the moment, it is under consideration by the Australian Standards Association, and with slight modifications it has a good chance of being adopted.

The publication of this standard places this country in the same position as France, Germany, and Sweden, where specifications have been under consideration for a long time. It is essential, to get the best from this work of standardization, that all foundrymen do their best to see that their new boxes —either bought or made in their own shops—conform to the conditions postulated. This will afford a good opportunity for scrapping box-parts located at the bottom of large piles and half-buried in mud, when the cost of putting into service would nearly equal the making of a better box. We hope that in a few years' time, at some meeting or other, a man at the back of the room will not express the view that it would be a good thing to standardize moulding boxes. We state this because it is only recently we heard a plea for the standardization of pattern colours for which a specification had been established many years earlier. It would be wise to take stock and ascertain which boxes already conform with the new specification and which now become bastard sizes. This adjective is not to be applied to the special-purpose boxes, which form and will continue as an important item in the equipment of many foundries.

Fulmer Research Institute

The Fulmer Research Institute, Stoke Poges, last week held an open day to celebrate the end of its first five years of successful existence. It was created through the initiative of the late Col. W. C. Devereux, C.B.E., with the object of carrying out sponsored research, much in the same way as the Battelle and Mellon Institutes in America. In this first five years, under the direction of Mr. E. A. G. Liddiard, M.A., the staff has, since the inception of the laboratory, grown from 44 to 84, whilst the income has increased from £24,900 to £78,000. It is a non-profit-making company and all monies received in excess of outgoings are ploughed back. It is extensively used by Government departments, American and Canadian interests, and to the extent of 36½ per cent. by private British industry. Amongst these are quite a number of foundry concerns. So far 85 Patents have been applied for, and in most cases granted, on behalf of the sponsors. The equipment, much of which has been designed and constructed in the laboratory, is well suited for carrying out both industrial and scientific research. In the experimental casting shop the following plant has been installed:—A Durville casting machine; an indirect-arc furnace for precision casting; direct-arc furnace for casting reactive metals of high melting point; high-frequency motor generator set with auxiliary furnaces; a vacuum melting and casting plant; a gas-filled kiln for firing refractories (maximum temperature 1,750 deg. C) and a 60-ton hydraulic press.

Advantage was taken of the occasion to unveil a plaque commemorating the late Colonel Devereux as the founder of the laboratories. It will be remembered that Colonel Devereux was the "Edward Williams" lecturer at an Institute of British Foundrymen's Conference held just after the war.

Notes from the Branches

London—East Anglian Section

The East Anglian section of the Institute of British Foundrymen visited Lake & Elliot, Limited, on September 16, when 40 members were shown round the foundries, machine shops and compressor house. Mr. V. W. Child, past-president of the section, in conveying a vote of thanks to Lake & Elliot, Limited, said that it was ten years since the section had visited these works, and it was interesting to note the new installations and the developments in foundry technique which had taken place in that time. Mr. W. L. Hardy made suitable acknowledgment for the company.

"Better Housekeeping" Week.—Accles and Pollock Limited, Oldbury, are giving awards to the value of £150 in connection with the campaign for good housekeeping in factories culminating with the national "Industrial Better Housekeeping" week from October 6 to 10. General Electric Company, Limited, Witton, are also offering cash prizes to employees, while literature about tidiness and safety is being distributed in factories of the Tube Investments Group.

It is announced that the Butterley Company, Limited of Ripley, Derbyshire, have secured a five-year contract with the British Railways for more than 5,000 16-ton all-steel mineral wagons, for main-line work. A contract for 4,600 wagons has also been given to the Derbyshire Carriage & Wagon Company, Limited, Chesterfield.

I.B.F. Golfing Society

The Golfing Society of the Institute of British Foundrymen held its seventh annual meeting at Woodhall Spa on Saturday and Sunday, September 27 and 28. The weather was almost perfect on both days, with plenty of sun and a little wind to make the golf more interesting. The result was that the scoring was exceptionally good.

Saturday morning: *Stroke competition for the I.B.F. handicap and scratch cups* (38 *competitors*).

RESULTS

(1) E. G. Evans ...	90	– 21 =	69	Winner handicap cup
(2) P. B. Higgins ...	83	– 10 =	73	
(3) Wm. Jones ...	98	– 23 =	75	
(4) P. G. Pennington ...	87	– 12 =	75	
(5) L. A. Bailey ...	84	– 9 =	75	
(6) M. H. Hillman ...	79	– 3 =	76	Winner scratch cup
(7) H. C. Hanson ...	98	– 22 =	76	Veterans prize
(8) R. C. Shepherd ...	92	– 16 =	76	

In addition to holding the respective cups for one year, the winners also receive a tankard each, kindly presented by Mr. Colin Gresty, immediate past-president of the Institute. The veterans prize was kindly presented by Mr. R. S. Darby.

Saturday afternoon: *Greensome foursome* v. *bogey*.

Winners:

(1) P. G. Pennington and H. Oliver ...	11	– 5 up
(2) R. B. Templeton and E. G. Evans ...	11	– 3 up
(3) P. B. Higgins and H. C. Hanson ...	12	– 2 up
(4) L. Mortlock and J. Bell	11	– 1 up

Sunday morning: *Four-ball foursomes* v. *bogey*.

Winners:

(1) P. B. Higgins ... 10	and G. W. Nicholls ...	14	– 10 up
(2) J. G. Phillips ... 12	and W. Jones	23	– 6 up
(3) C. H. Wilson ... 22	and P. Pennington ...	12	– 6 up
(4) W. J. Proctor ... 13	and H. Morton	11	– 5 up

The winners received a chromium-plated Lincoln "Imp" each kindly presented by the Lincolnshire branch of the Institute.

Ladies' competition: A ladies' bogey competition was held on Saturday morning for which there were ten entries:—

Winners:

(1) Dr. May Pearce	(32)	– 3 down
(2) Mrs. Arthur Phillips	(29)	– 4 down
(3) Mrs. Norman Cook	(11)	– 7 down
(4) Mrs. Leslie Mortlock	(36)	– 12 down

The winner received a chromium-plated Lincoln "Imp" also presented by the Lincolnshire branch. Both the winner and the runner-up were presented with half a dozen golf balls by R. B. Templeton, president of the Society.

At the annual meeting of the Society with Mr. R. B. Templeton in the chair, the prizes were presented by Dr. C. J. Dadswell, president of the Institute and the following office-bearers for next season were elected:—As president, Mr. R. B. Templeton; committee, Mr. E. Phillips, Mr. J. Bell, Mr. R. C. Shepherd, and Mr. F. A. Wilson (hon. sec.); and as vice-presidents, Mr. P. H. Wilson, O.B.E., Mr. V. C. Faulkner, and Mr. R. C. Shepherd. In addition to 40 competitors, there were 30 wives and spectators in the party. In view of the continued successes of these golf meetings, it was unanimously decided to hold the 1953 meeting on September 26 and 27, again at Woodhall Spa.

Dinner

COMPLIMENTARY DINNER TO MR. S. H. RUSSELL

At the Grand Hotel, Leicester, Mr. W. S. Russell presided over a dinner organized by the directors of S. Russell & Sons, Limited, to mark the 50th anniversary of Mr. S. H. Russell's business life, the whole of which has been spent with the firm of which he is now chairman. He was the recipient of presents from the directors, a silver gilt bowl, and binoculars from the senior staff and the Quarter-Century Club. About 170 members of the firm and guests were present. The toast of the visitors was proposed by Mr. P. A. Russell and responded to by Mr. T. Makemson. Amongst the guests were Mr. & Mrs. V. C. Faulkner, Mr. & Mrs. J. Gardom, and Mr. & Mrs. Perry.

New Coremaking Machine

Traditionally, the process of making dried-sand cores for the quantity production of light castings involves the compounding of a sand yielding suitable properties in the "green" and baked conditions. Then follows its consolidation in a corebox by hand- or machine-ramming, or by blowing; stripping; transferring to an oven; baking; inspecting; and, maybe, surface coating; and finally transporting to the foundry. A new process evolved by the staff of Ferranti Limited embodies the formulation of core-sand without consideration of the properties needed in the "green" state, as all handling in this condition is eliminated. Very briefly, the process is carried out on a turntable designed for operation by three girls seated around it. The first operates a bench-type core-blower; the second an automatic electric drier, whilst the third opens the corebox and removes the core. Whilst, at the present stage of the development, the cores are subjected to a further baking, as only skin-hardness has up to then been imparted, the future may see the elimination of this subsequent phase.

When a foundry, such as is the case of Ferranti Limited, is associated with an enterprise which produces a considerable number of plastic mouldings, it is perhaps not unnatural for comparisons to be made between the methods employed in coremaking and those used in the manufacture of plastics. In both cases, there has to be made a mould, die or corebox, formed in the shape which it is desired ultimately to produce; in both cases the manufacturing material has to be packed into that mould and in both cases the material cannot be persuaded to conform permanently to the desired shape until heat has been applied.

It is only in this last phase that in general principles the two processes diverge. In the case of the plastic moulding, the heat is applied while the material is still in the mould, whereas in the case of the core, the sand, in a very delicate state, is carefully withdrawn and subsequently baked. This part of the operation in the case of coremaking introduces troubles. First, the packed sand may be deformed as it is withdrawn, and secondly as it is heated it may become plastic and consequently lose its shape by sagging, to a greater or lesser extent. That this is a common source of trouble is evidenced by the fact that the shape of the corebox frequently has to be made "wrong" to make the cores "right" and also that where the shape does not permit of a flat base to the core, much money has to be invested in the production of core shells of the correct contour to provide support until the core is baked. From these comparisons of two entirely different processes, it was a very short step for the technicians in the Ferranti foundry to start thinking in terms of baking the core whilst it was still contained in the corebox, and in 1947 initial experiments on these lines were started, which led subsequently to the lay-out shown in Fig. 1.

Plant Used

This comprised a corebox, suitably dowelled, whose outer shape was made in the form of a cone and so fitted as to have good surface contact with the inside of a cast-iron chase, which performed two functions. First, it held the two halves of the corebox tightly together during the blowing operation, which in this case was performed with a standard Redford-type core-blower. Secondly, the chase itself, heated by a series of electrical resistance-elements clamped on its exterior and enclosed within an outer casing, transmitted heat to the corebox at a sufficiently high rate to ensure that the sand, when entering the box, was baked whilst still contained therein. The introduction of a thermocouple and suitable thermostatic control gear, ensured that the temperature could be established at a pre-determined value and then kept constantly at that figure.

Experiments in the production of cores using this set-up established the fact that the method functioned with a very wide range of core-sand mixtures, using many types of binder, including linseed oil, cereals and the resins. One of the principal difficulties was the time over which the core had to remain in the box to ensure complete baking. Unless this could be reduced it was apparent that the process had no commercial value. Attempts to reduce the time cycle produced cores which, whilst baked on the outside, were still "green" in the interior. These cores were removed at this stage and subsequently received secondary treatment in a vertical core-stove in the established way. It was found that the hard outer crust formed by the initial baking, which conformed very precisely to the original corebox shape, was in no wise altered by this routine.

Production Basis

It was then decided to go a stage further and produce a continuously-operated version on the same basic principles as the experimental work had established, that is, a means of blowing sand into the corebox, a mechanical system of venting and a device for withdrawing and opening the corebox so that the core could be removed and the cycle repeated. A different system of heating was evolved. For this case the conical chases were maintained at the operating temperature by a low-frequency induction-heating coil, again thermostatically controlled. Power for the coils and supplies for the thermostatic control gear was taken from a series of slip-rings mounted around the centre column. Core-blowing was still performed by a standard Redford-type blower. Venting was achieved by a needle plunger operated by a pneumatic cylinder which pierced the centre of the core subsequent to the blowing operation, and ejection was by means of a pneumatic ram which forced the corebox upward, the two halves opening

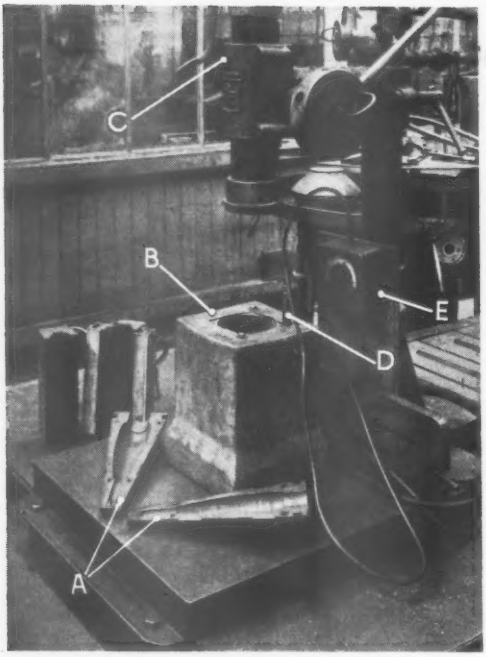

FIG. 1.—*Original Arrangement for Blowing and Baking Cores Simultaneously.*

A—Corebox in halves, cone-shaped on the outside.
B—Cast-iron chase, cone-shaped inside to receive corebox and heated by resistance elements.
C—Core-blower.
D—Thermocouple.
E—Thermostatic temperature control.

outward on their hinge by the employment of a wedging device. Rotation of the table was by hand and embodied a system of indexing so that the table always came to rest opposite one of the three stations.

Method of Operation

After ejection of a core, the box was withdrawn into its chase and the operator at the first station then moved the table round by 120 deg., bringing the box before the operator at the second station, who blew the core and simultaneously vented the core lying at the third station. Whilst this was going on, the operator at the first point ejected the next corebox from its chase, lifted out the hot core and placed it on a stand so that it could travel along a conveniently-placed conveyor to the core-stove for the secondary drying operation. It should be stated at this stage that the core, though very hot and necessarily having to be handled with gloves, was extremely robust and would stand a considerable amount of handling without any danger of breaking or even minor damage. The cycle was then repeated.

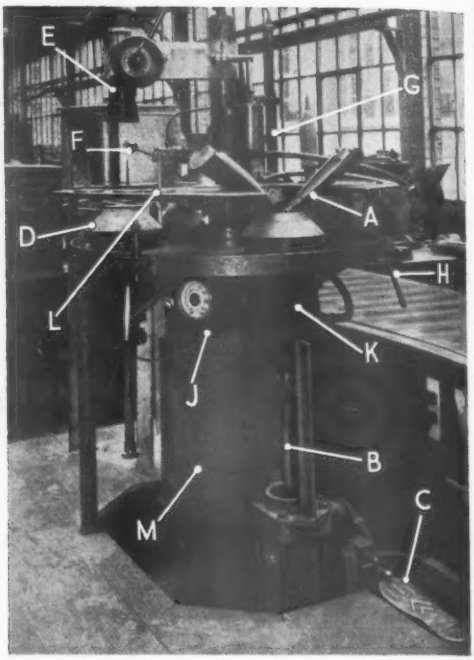

FIG. 2.—*Rotary 3-Station Coremaking Machine developed from the Prototype shown in Fig. 1.*

A—Corebox, just ejected and opened, with a core lying on the left-hand half, ready for removal.
B—Corebox ejector ram.
C—Pedal control for B.
D—Next corebox ready for core-blowing.
E—Core-blower.
F—Control valve for venting the core at G.
G—Pneumatically-operated core-venting device.
H—Table indexing lever.
J—Thermostatic temperature controller.
K—Chase enclosing the corebox and heated by a low-frequency induction coil.
L—Stands to place cores on before passing them to the conveyor on the R.H.S.
M—Cover over slip-rings for the electrical gear.

Production Possibilities

So far as the development work on this method of coremaking has been taken, a dried core is produced every minute, but it is obvious that by the introduction of more stations at the rotary head, this cycle time can be still further reduced and a machine on the lines indicated is now in hand.

The similarities of this method to the Croning process are immediately obvious, although at the time that development work was commenced, Ferranti engineers were not aware of the work which was being done on shell moulding. There are certain basic differences, in that no attempt is made to make a shell core; the method functions satisfactorily with a wide range of binders and does not necessarily involve the use of a synthetic resin; heating of the corebox is performed by conduction from a large separately-heated mass; and the sand is forced into the die under pressure.

I.B.F. National Works Visits

Brief Accounts of Establishments to be Inspected on October 24

(*Continued from page* 383)

CARDIFF FOUNDRY & ENGINEERING COMPANY (1947), LIMITED

The present premises of the Cardiff Foundry & Engineering Company were acquired by the B.S.A. Tools Group in 1947, for the express purpose of ensuring a continuous supply of machine-tool castings to their main shops at Mackadown Lane, Birmingham, and other factories in the tools' group. It is a modern iron foundry centrally situated, covering a total area of 9,500 sq. ft. The main building is 500 ft. long and 60 ft. wide, with annexes running the whole length of both sides. This main bay is split into three sections, the first for heavy floor-moulding, the second for machine-moulding work, and the third contains a mechanized conveyor unit. This conveyor is made up of 88 plates 4 ft. 6 in. by 2 ft. 6 in., and is served by four jolt-squeeze moulding machines. Castings are conveyed from the machines to the castings bay and from there on proceed to the knock-out unit where the boxes are pushed off from the conveyor by an air-operated ram. The sand from the boxes is then conveyed by underground belts and elevators to the sand reconditioning plant, and this sand is finally returned to the machines on an overhead conveyor belt delivering into the various sand hoppers.

In the main bay, a view of which is shown in Fig. 7, are three electric gantry cranes of 60-ft. span, two with a lifting capacity of 10 tons and one of 5 tons. Altogether in the foundry there are twelve moulding machines, the largest having a table of 9 ft. by 5 ft. and capable of handling moulds up to 10 tons in weight. This particular machine is served by a Sandslinger. The melting unit consists of three cupolas, two of 3 ft. internal dia. and one of 2 ft., the larger ones having a melting rate of approximately 3 to 4 tons per hr. Included in this bay are five large mould- and core-drying stoves which are coal fired by automatic stokers and are fitted with thermostatic controls. In the annexes are two coreshops, in one of which women are exclusively employed for the production of the smaller cores.

Ancillary Sections

The foundry has a well-equipped laboratory to deal with the sand testing and various metal analyses. The fettling department, which is adjacent to the foundry, is 200 ft. long and 25 ft. wide, equipped with modern grinding and fettling machines, and there has been recently installed a large Wheelabrator plant of the dual-table type capable of shot-blasting 2 tons of castings per cycle. A paint-spraying plant has also been installed for applying a priming coat to castings before delivery.

There is a large, modern patternshop containing machines suitable for the production of both wooden and metal patterns. Adjacent to the patternshop are the main offices, also a large canteen

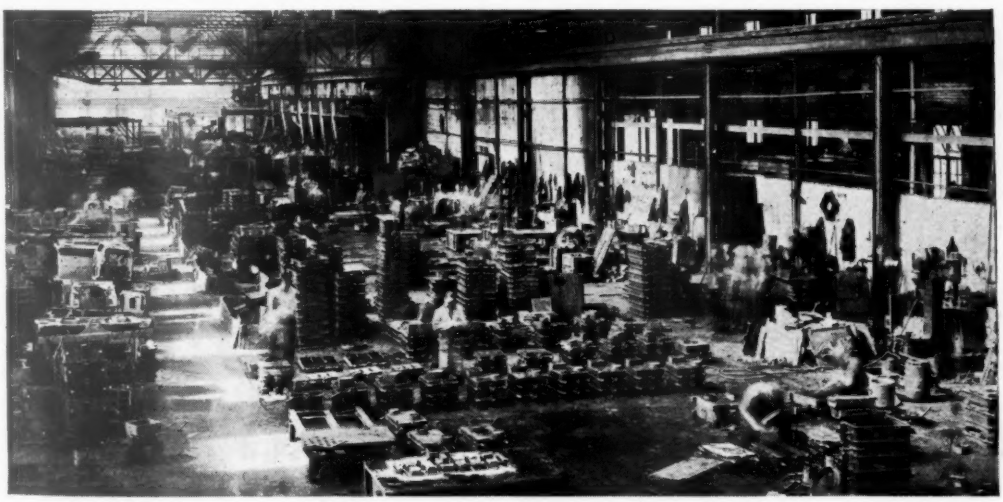

FIG. 7.—*View of the Main Foundry Bay at Cardiff Foundry & Engineering Company* (1947), *Limited.*

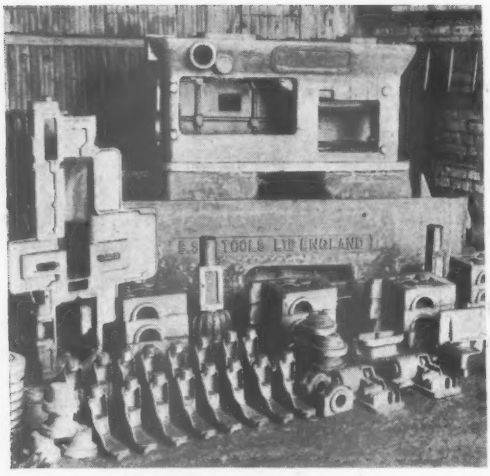

FIG. 8.—*Selection of Castings produced mainly for the B.S.A. group by the Cardiff Foundry & Engineering Company* (1947), *Limited.*

and kitchen capable of catering for all personnel, which at present number approximately 250. Up-to-date washing facilities and clothes-drying equipment are also provided for the employees.

Castings produced are mainly machine-tool castings for automatic machines, lathes, grinding machines, Gridley's, etc., which are manufactured by the parent company at Birmingham and elsewhere. Other general engineering castings are also manufactured to make up an approximate weekly tonnage of 55 to 60 tons. A group of typical castings produced by this firm is shown in Fig. 8.

W. A. BAKER & COMPANY, LIMITED

The foundries and engineering works of W. A. Baker & Company, Limited, at Newport, Monmouthshire, cover 14 acres and comprise iron, steel and non-ferrous foundries, together with patternshops, machining, fitting and erection departments, and include the production of a comprehensive range of castings, finished, machined and fitted products for general and specialized engineering, much of which is for export.

A survey of foundry production logically begins in the patternshops, which are equipped for the production of both metal and wooden patterns and coreboxes for supplying all four foundries. They are well provided with modern machine-tools for the production of precision equipment and tackle especially for the mechanized foundry.

The steel foundry, using high-frequency electric melting furnaces, is engaged in the production of straight carbon or alloy steel castings up to 8 cwt. of a varying range for many purposes and besides this produces intricate castings in stainless steels for the paper-making industry (see Fig. 9). Both machine- and floor-moulding processes are extensively used and all castings are annealed in modern furnaces. At the present time, important Government contracts are being executed and in order to cope with increased requirements the high-frequency melting plant is being enlarged.

Iron and Non-ferrous Sections

The iron foundry produces castings up to 10 tons principally comprising very large castings for pulping machinery which are mainly made by loam and dry-sand moulding. It is equipped with three 5-tons per hr. cupolas, four drying stoves, 10-ton overhead cranes, transfer cranes leading into the fettling bays, and one bay which has recently been semi-mechanized is in continuous production on medium-size green- and dry-sand moulded jobs. A group of castings is shown in Fig. 10.

The non-ferrous foundry has, from time to time, undertaken architectural work in bronzes and other non-ferrous metals, and is continually producing for the iron, steel and engineering trades a varying

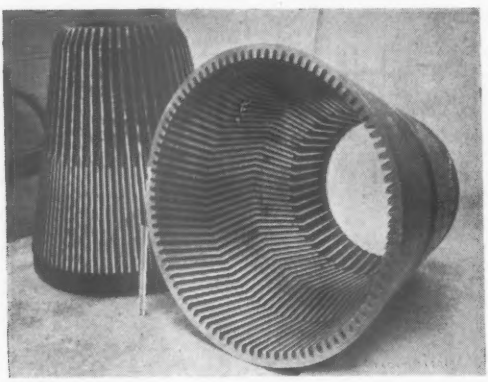

FIG. 9.—*Special Castings in Stainless Steel, weighing 12 cwt. each, produced by W. A. Baker & Company, Limited.*

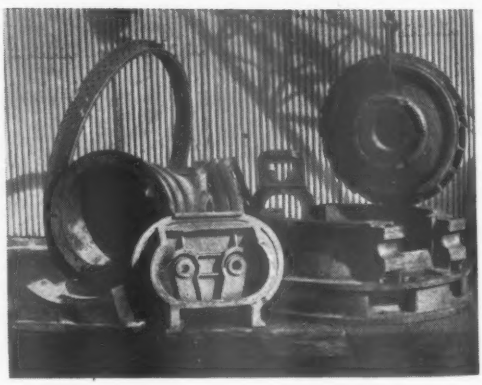

FIG. 10.—*Group of the Larger Castings, made up to max. of 5 tons, in the Semi-mechanized Section of W. A. Baker's Foundry.*

[Courtesy, Paterson Hughes Engineering Company, Limited.

FIG. 11.—*View in W. A. Baker's Mechanized Foundry showing Cupolas and Pouring Runway.*

range of brasses, aluminium, gunmetal and alloy castings such as bearing-brasses, valves, pump-impellors, sleeves and liners, copper tuyeres, anodes, and rolling-mill bearings. It also undertakes the white-metalling of large and small bearings used in the rolling-mill and allied trades.

The mechanized iron foundry, with its four, 3-tons per hr. cupolas has a substantial output of the light-section castings and is provided with a moving pallet-type track with several pairs of Coleman pneumatic moulding machines adjacent for continuous moulding and casting. There is a self-contained mechanized sand-treatment plant. The boxes are pushed off the pallets by a pneumatic pusher on to Sterling knock-outs and the castings, discharged on to a cooling conveyor, are given four to five hours before being discharged by a slat conveyor into the fettling-shop. The plant provides for the underground return of all used sand to the sand plant where it is treated for further use. This light section caters for cored or solid castings up to 80 lb. in weight, and is at the present time handling a varying range for the electrical, motor-car and light-engineering industries, as well as important government work. The adjoining bay is provided with Sandslingers and larger Coleman machines capable of more intricate and heavier castings, and here also the supply of sand to the machines is by overhead conveyors and return underground. The foundry is provided with a sizeable coreshop equipped with Acme stoves for continuous drying, core-blowers, core-sand mixers, and core conveyors to the stoves to achieve the minimum loss of time in transport. A view in the mechanized foundry of cupolas and the pouring runway is shown in Fig. 11.

The engineering section of the works has a comprehensive range of machine-tools for undertaking all sorts of operations such as horizontal boring, vertical boring, grinding, centre-lathe turning, and milling and there is an "automatic" section for the machining of repetitive work. A further bay is devoted solely to fitting and erecting of complete machines and plant. A corner of this section is allotted for the construction of mild-steel fabrications, covering both welded structural steelwork and platework. At the present time the company is engaged on a varying range of machined and erected work for the paper-making industry, for municipalities, corporations, and the fuel and power industries. The whole works is self-contained in so far that complete jobs can be undertaken from basic raw-materials to the finished product, covering all processes from the patternshop to the final complete assembly.

GOULDS FOUNDRIES, LIMITED

Over 70 years ago, Goulds Foundries at Barry first started producing ferrous and non-ferrous castings to serve the specialized needs of the ship-repairing industry in the Bristol Channel. This industry is still served by their Cardiff foundry, which produces many types of marine castings as well as general-engineering castings in grey iron up to 17 tons and in non-ferrous metals up to 30 cwt. in weight. During the war, the Newport jobbing foundry of this firm, introducing Meehanite metal, was called upon

by the Ministry of Supply to re-design many gun parts for production in this material as a substitute for other materials, and so developed this works into a batch-production foundry. As this business increased, it showed the need for quantity production, and it was finally decided to reorganize and substantially extend the foundry. A fully-mechanized unit, therefore, was planned in such a way that certain features, such as patternshops, ablutions block, maintenance shop, stockyard, laboratory, etc., should be be shared with the jobbing section, and one of the features of the present works is its general compactness. At the same time, the jobbing foundry was itself extended.

Jobbing and Mechanized Plants

The jobbing foundry produces all grades of Meehanite metal, by floor moulding, moulding machines and Sandslinger, in castings weighing from a few pounds up to three tons. A good deal of development work has been carried out on special anti-abrasive and heat-resisting applications and these two lines, together with high-tensile irons, are the main specialities. The melting unit consists of two 1½ tons per hr. cupolas, the moulds being poured from an overhead gantry.

The mechanized unit (Fig. 12), housed in new buildings, was designed to produce castings from a few pounds up to 28 lb., as supplied to the automobile, general-engineering, refrigeration and agricultural trades as well as for special-purpose jobs. Coleman jolt-squeeze machines are used and moulding-box sizes are 16 by 16 in. and 20 by 20 in., with varying depths. The sand plant is completely mechanized, using a Foundry Equipment continuous mill. Moulding boxes are knocked-out by being delivered by a pneumatic pusher to a vibrating screen and castings are subsequently placed on a pendulum-type cooling conveyor leading to an overhead sorting platform, whence they are fed down a shute to a Wheelabrator. They then pass through a grinding section to the fettling and despatch bays. Melting for the mechanized section is by 3½ tons per hr. cupolas and metal is poured from a system of overhead runways. The charging platforms for both foundries are serviced by a yard gantry and crane from stock bins at ground level. Well-equipped fitting shops as well as metal and wooden patternshops enable the company to provide its own patterns and cater for machining as well as normal maintenance services. In all, approximately 200 people are employed.

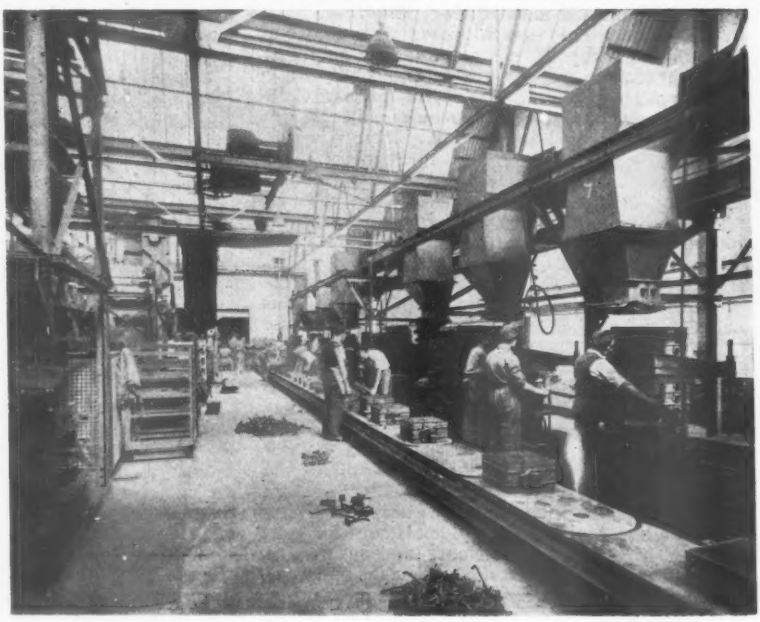

FIG. 12.—*View of the Mechanized Section at Goulds Foundries, Limited. Note the Unusual Design of the Sand Hoppers.*

BROWN, LENOX & COMPANY, LIMITED

Brown, Lenox & Company, Limited, had their origin in the invention of a form of chain in which the links are reinforced by the incorporation of cross-pieces, or "studs," to prevent their deformation. Known as "stud-link" chain, it was invented and patented in 1808 by Captain Samuel Brown — a fellow officer of Lord Nelson—and, in partnership with his cousin, Mr. Lenox, who financed the venture, they commenced manufacture at the Millwall works. This was the real birthplace of ships' chains as they are known to-day, for it was not long before the stud-link chain was approved by the Admiralty, and entirely superseded the hemp ropes previously used.

The works at Pontypridd, where the Rhondda and Merthyr valleys meet, was established in 1818, and the manufacture of chain was transferred there. The chain was originally forged, but, in 1920, the danger was foreseen of a shortage of craftsmen having the skill necessary to make the larger sizes of chain and other products which had in the meantime been introduced. In consequence, a steel foundry was built, and a patented process was developed for casting the chain in steel in continuous lengths up to 90 ft. or so. To-day, both the forging and the casting processes are

extensively used by the company, and a great diversity of other products associated with the mooring of ships, or with lifting gear and so on, are to be seen in both departments of the works—anchors, shackles, swivels, and the like.

Layout

The works are situated alongside the canal, which originally provided a considerable proportion of the transport, both of coal coming in from the Rhondda mines and of iron from the Cyfarthfa Merthyr works and also for many of the finished products going to the seaport of Cardiff. To-day, the works covers an area of about 11 acres, divided roughly into three sections. The south end is used for the manufacture of wrought-iron goods for the chains, and for smithy work, the central area is the machine-shop, while the largest section, at the north end, consists of the forges and the steel foundry. The works employ nearly 500 people, of whom some 180 are in the foundry.

The steel foundry is housed in a building roughly 600 ft. long, with a width varying from 50 to 100 ft., with additional lean-to buildings accommodating the moulding machines and the light dressing shops. The main foundry bay is equipped with three overhead travelling cranes. Steel is produced in two 3-ton direct-arc, basic-electric furnaces designed and built by the company. Occasionally, these furnaces are used for producing a 6-ton melt in one ladle, but usually casts only amount to 3 tons each. At the present time, about eight heats a day are being poured. Machine-moulding is used for almost all

FIG. 13.—*Single-link Pattern, Joining-link Pattern, and a Core for producing Mooring Chains from Steel Castings at the Brown, Lenox Works.*

FIG. 14.—*Moulds in Various Stages of Production for making Lengths of Brown, Lenox Stud-link Chain.*

the specialized chain production (see Figs. 13 and 14) and ancillary gear, which amounts to some 40 per cent. of the foundry output, the remainder comprising general jobbing work, most of which is hand-moulded. Quite a large proportion of the jobbing work is of fairly small size and many examples of stack moulding are to be seen.

Further Treatment

After knocking out, the castings have their heads and runners removed by oxy-acetylene cutters using Ferro-gas as an inhibitor. The use of "atmospheric" heads is being developed, and these are used on all chain products and other repetition work. Dressing operations are carried out under the cranes, in the case of the larger castings, while the smaller work is treated in a Wheelabrator and then passed through the light dressing shops. The whole of the output is finally annealed, this heat-treatment being carried out in two pulverized-fuel-fired furnaces, the fuel-preparing plant being situated immediately behind one of the furnaces.

There is a comprehensive apprentice-training scheme in operation, running in conjunction with the local education authority. In addition to normal training, all foundry youths under 21 spend one day a week at instructional classes in both theoretical and practical work. These classes, both for Brown, Lenox employees and for those of other iron or steel foundries in the area, have been held until recently at this works. They have now been transferred to the local technical college, where the education authority has built a small demonstration foundry plant, and where one of the Brown, Lenox staff gives the lectures in practical work.

Worshipful Company of Founders.—The following officers of the Founders' Company have been elected for the year 1953: *Master*, Mr. K. H. Adams; *Upper Warden*, the Rev. R. B. R. Walker; *Under Warden*, Mr. G. W. Ilsley; *Clerk*, Mr. H. Wilson Wiley.

F

Shell Moulds for Jobbing Foundries

According to the "Iron Age," a Chicago company is considering selling shell moulds on a jobbing basis to smaller foundries in the Midwest. Moulds would be made by Powdered Metal Products Corporation on a new machine which the company has built and tested in its own shop.

The firm also plans to market or rent the shell-mould producing machine to foundries. As at present outlined, marketing plans would call for a $5,000 deposit; then the machine would be used on a rental basis. Or the customer could use his deposit as down payment toward purchase of the machine. Similar merchandising methods have been used successfully on machine-tools.

The company is also planning to supply a thorough engineering and maintenance service on the machines. They have even considered mixing sand and plastic and making this ready-mix available to users of the machine who lack mixing facilities. If these plans work out they will be another step forward making the advantages of the shell-moulding process available to small foundries.

Operation

The pilot machine, designed by George Bachner, is being used by the Powdered Metal concern in pouring small castings in high alloy and stainless steels. It is also being used in preparing moulds for non-ferrous castings, and has been operating in 12-hr. runs during the test period.

The Bachner machine is capable of 20 "shots" per hr., and is designed to handle a maximum mould size of 12 by 18 in. With an overall size of 6 by 12 by 11 ft., the shell-moulding machine is light, simple in operation, and would permit one-man operation when made fully automatic.

When the unit works automatically, the operator presses a starting switch and electrical relays carry the machine through its cycle. The sand hopper and the die which will form the mould are suspended in a light frame that revolves around an axis through which all wiring also enters the machine. At the rear of the machine an infra-red "furnace" slides over the mould die, curing the resin-impregnated sand mould in about 1 min. The full cycle for the machine is 3 min.

Human Relations in Industry.—The Ministry of Labour and National Service has issued a comprehensive report of the Human Relations in Industry Conference held in London last March under the auspices of the Ministry. The Conference was attended by about 400 delegates and observers, and the Report sets out in full many of the speeches and records the discussions and conclusions.

Saving Iron and Coke.—The Council of Ironfoundry Associations, of Crusader House, Pall Mall, London, S.W.1, has just issued a leaflet eminently suitable for distribution amongst foremen and supervisors in iron foundries. Under three headings, "Melted Metal," "Avoidance of Scrap Castings," and "Coke Economy," sensible hints are given, which if acted upon should result in the more economical conduct of the shop. Copies are available to our readers on writing to the Publicity Manager at Crusader House.

Historic Forge Becomes National Monument

Wortley Top Forge, in continuous use from the 17th century until 1914, has been bought by Sheffield Trades Historical Society, and is cited as a national monument. It probably dates back centuries earlier, as it was built on a site where Cistercian monks began the first iron-making in the North. The forge has had several narrow escapes from the scrap dealers, and the Ministry of Supply itself was only dissuaded from commandeering the metal by an appeal from Sir Allan Grant, of Sheffield.

The Society hopes to transform the forge into "a living example of a 17th century ironworks," and appeals to people who have knowledge of the methods of the times, or who have examples of the tools then used, to get in touch with them. They also plan a "repository of iron-making traditions," and among the items already collected are cannon-balls made at Wortley for use in the Civil War, and thigh-length metal boots used to protect the iron-makers from the sparks and pieces of slag which flew about when unrefined iron was worked.

With water power for bellows, mills and hammers, deposits of ganister for making firebricks, and supplies of charcoal from nearby Wharnscliffe Woods, Wortley, is an epitome of Sheffield's early history in the craft of iron-making. The first iron combine before the Industrial Revolution, the "Spencer Syndicate," was centred here, and here also were carried out some of the first experiments in adopting the new "blast" system, and in quenching hot iron at sub-zero temperatures—for which snow was imported from Norway. As the first industrial works to become a public monument, Wortley will be unique in the world.

I.B.F. Student's Grant

The student's grant committee of the Institute of British Foundrymen is now prepared to consider the award of a further grant in 1953 and applications are invited from young foundrymen or students, preparing for work in the foundry industry. In general the award will be confined to applicants of under 30 yrs. of age and is primarily intended for those who wish to take a course at the National Foundry College, though in very exceptional circumstances the committee will be prepared to consider rendering assistance for some other form of study. Applicants should be of the educational standard necessary to secure admission to the College. Members of the Institute are invited to co-operate in securing applications from suitable candidates, which should contain the following information:—(*a*) name, address and age; (*b*) name and address of present employer; (*c*) a chronological account of previous experience and (*d*) a chronological account of educational qualifications and technical studies. It will be the endeavour of the Council to secure the co-operation of the selected candidate's employers in ensuring him continuity of employment.

Applications should be addressed to the Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester 3, not later than March 31, 1953.

WE OFFER our congratulations to our esteemed German contemporary, *Giesserei-Praxis*, on attaining the 70th anniversary of its foundation.

Television in Metallurgical Industries

Potential Applications for Foundries

The radio and television show in London recently went farther than presenting the latest radio set or television receiver to the general public. It focused attention on the great advances made in electronics by British skill, and led to contemplation as to its fuller use, in industry as well as in the home.

The use of G.E.C. radio communication and sound reproduction equipment by a modern industrial undertaking was on show as one typical application in this new and rapidly expanding field. A scheme was depicted which enabled immediate speech communication with mobile units outside a factory and all points within it from a communication control room. From this central point, communication by V.H.F. radio telephone was shown with locomotives in a shunting yard; cars, lorries, etc., on roads within range of the factory; and with working parties using man-pack type transmitter-receivers. Internal communication was by means of a factory industrial sound system using a 300-watt twin-bay track assembly with various types of loudspeakers distributed throughout the factory. Facilities were included to provide for fire alarm and time signals, staff location and the inevitable "Music while you work.". Examples of radio telephone transmitter-receivers were included for similar application such as air-ports, police, fire services, road transport, tugs, launches, etc.

A display by Mullard Limited included examples of the progress of electronics in the fields of industry and research. There was, for instance, a grid-controlled type image converter capable of photographing phenomena occurring in 10^{-8} sec.

The potentialities of television in industry are enormous for control apparatus, viewing from hot or dangerous positions, transference of information, microscopy, managerial control, instructional purposes and many other applications. Its advent should be developed logically, with full co-operation between user and supplier.

Supervision of Processes

An example of its use in a steel mill is its adaptation at the works of the U.S. Timken Roller Bearing Company. A despatch man, who had to control the speed for the conveying system transporting seamless tubing into low-temperature furnaces, virtually had to be in two places at once. Due to the arrangement of the conveyor system and the furnace, it was necessary for him to be located 80 ft. from the charging end of the furnace. From that distance it was impossible for him to detect a jamming of the flow of tubing. To solve the problem, Timken engineers* installed a television camera aimed at the furnace door. A coaxial cable connected the camera with a receiver near the dispatcher 80 ft. away, and ease of control was thus effected. Other opportunities that exist for the expansion of television into the industrial field may be envisaged in the charging of cupola furnaces and the filling of hoppers and stock bins. In America a case is cited of television as applied to scrap baling.†

In applying successfully any instrument or appliance to industry, many design factors have to be considered, such as operating conditions, heat, cold, dust, dirt, humidity, personnel handling such equipment—will it be handled by skilled technicians, or ordinary factory help such as a plant electrician, mechanic, or carpenter? Many good ideas conceived in an air-conditioned laboratory, and in the hands of expert technicians, have met with complete failure in the field because field conditions had not been considered. The components that are selected to go into an overall design have to be given careful consideration from an engineering and operating standpoint. It can easily be seen that a component might be designed to run at ordinary room temperatures, but in industry it may be subjected to abnormal conditions.

Use in Furnace Operation?

In the discussion of the development of a new American industrial camera plus screen television equipment,‡ the producer was asked about its future possibilities in blast-furnace work by Mr. J. J. Alexander of the Republic Steel Corporation, who said that he was of the opinion that industrial television would find its greatest application as a method of observing a production process that was inaccessible to other forms of communication. "Would it be possible," he asked, "to operate and maintain a television camera below the large bell of a blast furnace? If installed to withstand pressure, temperatures and abrasive dust conditions that exist above the blast-furnace stock line, the picture should provide information that would result in improved blast-furnace production. Much better distribution of ore, stone, and coke should be obtained if it were possible to observe the material as charged into the blast furnace while in operation. It should be possible to vary charging practice to obtain the desired distribution of material. An improvement in uniformity of the burden should provide more intimate contact of gas and material with a resultant increase in iron production."

Mr. J. A. Good, for the equipment producer, replied: "The equipment can see anything that you can see with the human eye. In a few cases it can see some things that cannot be seen with the eye, *i.e.*, infra-red light. A filter can be used to remove visible light and still the equipment can see it. The fact that it can see in the infra-red range leads me to believe that it can be used where we have a lot of gases and probably many of the dusts. It has found its use in ability to see through certain fog conditions where the eye cannot see. If the dust and dirt referred to are of the type that will not filter infra-red, and it is difficult to filter infra-red, I think we can see it. The second question —Will it stand temperature and pressure? The equipment, as it is made, is made to stand temperatures of approximately 150 deg. F. Not much has been done on pressure. The Diamond Power Specialty Corporation, Lancaster, Ohio,‡ however, is now constructing a unit for the Army which will stand an internal explosion and keep out all the toxic gases found in the explosion of equipment. The equipment can be placed in a sealed case and optic windows used which can stand high temperatures—1,000 deg. F. or higher—because the windows are air cooled and of pure quartz. The equipment has already been used to see into furnaces in connection with power plant fields, where a camera was placed in the roof of a furnace to watch the burners in the various corners.

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* *Materials and Methods*, Aprll, 1952, p. 9.
† *Steel Processings*, December, 1950, p. 634.
‡ J. A. Good, *Iron and Steel Engineer*, March, 1951, pp. 107-11.

Television in Metallurgical Industries

The pioneer work undertaken in Great Britain, not only providing the first public television service in the world, but also in being responsible for many detailed applications since that time, should be placed on record. This was well achieved at the television convention held earlier this year in London, organized by the Institution of Electrical Engineers (Radio Section).

There are many further applications for television. A representative cross-section would include microscopy, location of opaque objects, preparation of printing blocks, transmission of documents, viewing of dangerous processes, observation of high-speed phenomena, intensification of X-ray images, photographic film manufacture, measurement of infra-red colour temperature.

Dr. F. Roberts, backed by the Nuffield Trust, has developed a television microscope at a London university which can magnify up to 25,000 times. This could, no doubt, be developed for metallurgical work.

A further new application of television is the control of overhead travelling cranes. This was demonstrated at Olympia, London, in June, during the Mechanical Handling Exhibition. The Vaughan Crane Company, Limited, Manchester, has developed this idea, and now produces radio- and television-controlled cranes for industrial use.

The brief survey has only touched on the possibilities of this new medium, but such uses in industry as the control of melting furnaces, etc., and continuous strip mills, where at the present time it is normal practice to instal complicated inter-communication systems, are two uses which can be envisaged in the immediate future.

European Steel Output

Crude steel production in Europe (excluding the Soviet Union) during the second quarter of this year substantially maintained the record rate attained during the first quarter, according to figures issued by the Economic Commission for Europe. A higher rate of increase in pig-iron production, as compared with crude steel production, underlines the greater reliance on pig-iron instead of scrap in steel production, supplies of war-damaged scrap now being practically exhausted. The following table gives details in metric tons.

	1st quarter, 1952 (annual rate).	2nd quarter, 1952 (annual rate).	July, 1952 (annual rate).
REPORTING COUNTRIES:			
United Kingdom ..	16,244,000	16,360,000	14,466,000
Western Germany ..	15,236,000	14,900,000	16,536,000
France	10,684,000	10,912,000	10,368,000
Belgium	5,452,000	5,080,000	4,248,000
Italy	3,404,000	3,516,000	3,552,000
Luxembourg ..	3,164,000	2,884,000	2,892,000
Saar	2,764,000	2,732,000	2,892,000
Sweden	1,668,000	†	†
Austria	1,108,000	1,044,000	†
Spain	848,000	†	†
Netherlands	584,000	572,000	†
Others	1,264,000	†	†
TOTAL	62,420,000	61,900,000*	†
OTHER COUNTRIES:			
Poland	3,188,000	3,128,000	†
Czechoslovakia ..			
Eastern Germany ..	7,300,000*	7,600,000*	†
Hungary			
Rumania			
TOTAL	10,488,000*	10,728,000*	†
TOTAL EUROPEAN PRODUCTION	72,908,000*	72,628,000*	†

* Estimated figure. † Not available.

Book Reviews

Material Handling in Works Stores, by L. J. Hoefkens. Published by Iliffe & Sons, Limited, Dorset House, Stamford Street, London, S.E.1. Price 10s. 11d., post free.

This well-illustrated book stresses the use of the fork-lift truck and pallet system—a method unfortunately of only limited value in most foundries. This statement, of course, does not apply to the larger ones, where increasing use is being made of their potentialities. The author has divided the book into two main sections, the first of which deals with theory, and covers such subjects as the plant used and planning new methods. In the second part, the author gives examples from practice, taking the subject from the receipt of raw materials, storage, processing through the works to the final despatch. His last section (13) deals with the interesting subject of swarf and scrap handling. In the case cited, there was 130 tons of barends, scrap castings and swarf of various kinds to be shifted. Containers to carry a ton and capable of being stacked three-high were provided. A new building was provided to handle the swarf and recover the oils, paraffin and trichlorethylene. A complete well illustrated description is given of the whole system. For the larger engineering shops, this book is most valuable.

Productivity and Probability, by T. F. O'Connor, B.Eng. Published by Emmott & Company, Limited, 31, King Street West, Manchester. Price 5s.

At the end of his introduction, the Author suggests the all-round advantages to be derived from time-studies should be a subject for instruction of their members by the trade unions. After perusing this 193-page book, the reviewer would suggest that facilities should be made available for trade-union executives to learn all about the potentialities of time-study and its industrial applications. Moreover, he would further suggest that it would be difficult to find a better text-book than this to use as a basis. It demands nothing more than a knowledge of elementary mathematics. The Author has not yet found a basis for the comparison of various productivities, but believes that, by the exchange of figures collected by the appropriate employers' associations, a basis may be forthcoming eventually. The book has no index and is devoid of chapters, but is no worse for that, as it is primarily a book to read and not a work of reference.

Crocketts Freight Reckoner. Compiled by G. R. Crockett, M.B.E. Published by Frederick Warne & Company, Limited, Chandos House, Bedford Court, Bedford Street, London, W.C.2. Price 17s. 6d. net.

This book is designed for the use of the shipping departments and includes tables for cubic feet up to £20 and weights up to £10. A section that savours of modern conditions covers air freight per kilogram. For ease in use the pages are thumb-indexed—value ranges appearing along the outer edges.

The Davis Equipment Company, 4,321, Hollister Avenue, Santa Barbara, California, wishes to act as distributors in South California for U.K. manufacturers of light agricultural machinery. Interested makers should write to Mr. Davis, the proprietor, at the above address, at the same time notifying the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference, CRE/31824/52), of any action taken.

Some Effects of Magnesium on the Formation of Graphite in a Solidifying Cast Iron*

By I. C. H. Hughes, B.Sc., A.I.M.

(*Continued from page* 391)

Non-inoculated Magnesium-containing Irons

Figs. 11 (*a*) to 11 (*f*) illustrate the progress of solidification of the non-inoculated magnesium-containing irons. Samples A and B resembled the corresponding samples in the inoculated magnesium-containing irons, but contained fewer graphite spheroids, which were nevertheless generally well formed. In sample C, where the eutectic reaction was just starting, it was evident that the spheroids which had started to grow showed irregular outlines. The graphite spheroids in these samples appeared to originate in the same way as in the inoculated irons, being mostly found close to the austenite dendrites. At all times during the eutectic reaction, illustrated in Figs. 11 (*c*) to 11 (*f*), the number of spheroids present was smaller than in the corresponding inoculated irons, and they were far more irregular in outline. The liquid remaining at each stage represented by samples A to D, produced the same type of acicular-austenite/carbide structure as in the inoculated irons.

Examination of samples E and F showed that the last liquid to solidify crystallized as iron-carbide eutectic, having an appearance similar to that in the white iron (Fig. 6 (*e*)). Solidification appeared to be complete in sample E, after a fall of only about 5 deg. C. in temperature from the maximum attained on recalescence. The quantity of carbide in sample F was less than that in sample E, and was substantially the same as that in the normally solidified sample (Fig. 6 (*d*)), suggesting that very rapid graphitization of some of the eutectic carbide had taken place after complete solidification of the iron.

The microstructures of this set of samples suggested that in the irons, carbon diffusion was hindered during transformation, so that the products of the eutectic reaction tended to be iron carbide and austenite, representing the least diffusion of carbon from a random dispersion (assumed to exist in the liquid), and the carbon which diffused to the spheroids appears to have done so in an irregular manner, causing them to grow progressively more imperfect in outline. This is thought to be a greater effect than could be explained solely on the basis of a reduced number of graphite particles.

General Considerations

In considering the implications of the results obtained on the quenched samples it is interesting to study the main features of the centres of crystallization of the eutectic liquid. In a flake-graphite iron the eutectic reaction produced a structure consisting of more or less spherical cells each composed of radiating flakes of graphite surrounded by austenite. Each of these cells presumably had one centre of crystallization, which might be a graphite particle or some foreign inclusion.

In the spheroidal-graphite cast iron, growth of the eutectic took place by the simultaneous deposition of austenite upon the envelopes surrounding the graphite spheroids and the diffusion of carbon to the spheroids. This must be regarded as a modified eutectic mechanism. Each spheroid probably represented one centre of crystallization, and it is immediately apparent that in the spheroidal-graphite cast iron the number of centres which grew as a result of the eutectic reaction was very much larger than in the flake-graphite iron. An attempt was made to calculate the number of centres of eutectic crystallization per cubic millimetre. Dunphy and Pellini counted the number of graphite particles per square millimetre in their samples and found a great increase in the number at the beginning of the eutectic reaction, the number afterwards remaining constant throughout eutectic solidification.

In the present work, in view of the wide variation in particle size from beginning to end of solidification, and of the range of sizes at any stage of solidification, an estimate was made of the distribution of particle sizes and thence, by calculation, of their number per cubic millimetre. Fig. 14 (*a*) shows a count obtained of particles per square millimetre in the inoculated spheroidal-graphite series, while Fig. 14 (*b*) shows the values obtained by calculation of the number of particles per cubic millimetre. If it is assumed that particles of less than 0.01 mm. diameter were formed on quenching, subtraction yields values shown in Fig. 14 (*c*). This is of the same general form as that obtained by Dunphy and Pellini for particles per square millimetre, and shows that the number of centres increased rapidly at the beginning of the eutectic reaction and then remained constant or rose very gently during the remainder of the reaction. The total number of spheroids in the solidified iron is of the order of 1,800 per cub. mm. Similar treatment of the inoculated flake-graphite iron samples yielded a value of about 10 cells or centres of crystallization per cub. mm. Here also the number rose rapidly at the beginning of the eutectic reaction and thereafter remained nearly constant.

The great difference in number of centres of crystallization of the eutectic in the flake-graphite and spheroidal-graphite irons may not be surprising in view of the supercooling of the spheroidal-graphite iron, which would be expected to result in

* Paper presented to the Buxton Conference of the Institute of British Foundrymen. The Author is attached to the Mond Nickel Company, Limited, Birmingham.

a high degree of supersaturation of carbon, possibly involving a higher nucleation rate. In each series, the samples containing the greatest number of centres of crystallization were those quenched from near to the beginning of the eutectic reaction. These samples must have cooled quite slowly at the start of quenching. Thus it seems reasonable to suppose that the nucleation of the centres of crystallization began at this temperature, and that it is justifiable to assume that all the spheroids seen in samples quenched from above the eutectic temperature were formed during quenching. Even so, it cannot be proved that nuclei did not exist at higher temperatures.

It is likely that nucleation of the centres of crystallization, once begun, would continue to occur during the eutectic reaction, provided that the temperature remained constant. The temperature did remain constant for a short period in the flake-graphite irons and in the magnesium-containing iron which was inoculated, but did not in the magnesium-containing non-inoculated iron or in the white iron. The experimental errors are very large in calculating the number of centres per cub. mm. and the curve shown in Fig. 14 (*c*) may, in fact, continue to rise slowly during the eutectic reaction. Continued nucleation during the eutectic reaction could not be responsible for the increase in number of centres observed early in eutectic solidification, as shown in Fig. 14 (*b*). It is unlikely also that the original nuclei of graphite flakes or spheroids, even if they are non-metallic particles, would be large enough to be visible under the microscope.

Small Inclusions

The samples contained a larger number of small inclusions than was expected to be present, although most of these were too small to be identifiable even at magnification of ×2,000, but the presence of manganese sulphide was noted in the magnesium-free irons, and some colourless crystals, believed to be compounds of titanium, were observed in all samples, whilst in the magnesium-containing irons very pale-grey, angular crystals were often seen. These may have been magnesium compounds. Amongst the unidentified inclusions there may well have been graphite particles either precipitated during quenching or else free in the liquid iron. In any case, the magnesium-containing irons did not appear to contain fewer inclusions than the magnesium-free irons.

The difference between the eutectic-reaction mechanisms described above for the two types of iron is regarded as being in accord with the slight difference in shape in the two cooling curves. If it is assumed that a few degrees of supercooling occurred normally in the flake-graphite irons, the initial growth of the eutectic cells might be sufficiently rapid to cause appreciable recalescence at the cooling rate employed. On the other hand, in the spheroidal-graphite iron, the form assumed by the eutectic cells, *i.e.*, with an austenite envelope around each graphite particle, would be expected to restrict and retard the early rate of growth sufficiently to prevent other than slight recalescence. Considerable recalescence was observed in the cooling curves of the non-inoculated magnesium-containing iron. This may be due to the increased supersaturation at the lower temperature reached, with consequent increase in initial rate of growth of the spheroids. The composition of the iron would be expected to have some effect on the degree of recalescence; the more nearly eutectic in composition, the greater would be the recalescence.

The depression of the arrest temperature observed in the cooling curves of magnesium-containing inoculated irons is in qualitative agreement with that observed in non-inoculated magnesium-containing irons by Dunphy and Pellini, whose curves are of a form similar to those reported in the present Paper. Piwowarsky's cooling curves for magnesium-containing irons, whilst exhibiting a similar depression of arrest temperature, are of a different general form from any which have been reported in this Paper.

Points of Correlation

The mechanism of solidification of the magnesium-containing irons suggested by these experiments is in agreement with some, at least, of the observed properties of magnesium-containing irons. The proximity of the first-formed spheroids to austenite dendrites would account for the observation of straight lines of spheroids in some microstructures and also, because of the way in which the austenite envelopes formed and grew into the dendrites, for the lack of segregation of graphite in centrifugally-cast hypoeutectic magnesium-containing irons.

It is very interesting to note the absence in the magnesium-containing irons of any of the fine graphite, commonly referred to as undercooled graphite, and designated by the A.S.T.M. as " type D." This type of fine graphite was found in the magnesium-free irons. The absence of " type D " graphite in the magnesium-containing irons might be a deoxidation effect, but might also be a composition effect, and absent from higher-silicon irons. The effect of variation in composition has not been studied, and the need for such study is clear in order to provide information on this point.

The irregular outlines of the graphite spheroids found in the non-inoculated magnesium-containing samples may be compared with the graphite structures obtained in inoculated, hypoeutectic, cerium-containing irons where irregularly-shaped graphite-spheroids frequently occur. It is suggested that cerium may require a normally unattainable degree of final inoculation if it is to produce, in hypoeutectic irons, structures containing perfectly-shaped graphite spheroids. It is probable, however, that in order to understand the individual peculiarities of different elements which can produce spheroidal graphite, they would have to be studied individually.

The intermediate graphite forms produced in low-magnesium-containing irons are worthy of considerable study. Dunphy and Pellini have reported that in this type of iron a progressive increase in the num-

ber of graphite particles formed during the eutectic reaction occurred.

The results obtained do not lend support to the theory of precipitation of the eutectic graphite in a spheroidal-graphite iron from first-formed supercooled austenite, nor to that of solidification as the austenite/iron-carbide eutectic and subsequent decomposition of the carbide, although this may occur as a contributory effect in non-inoculated or insufficiently-inoculated irons. The main features of spheroidal-graphite solidification appear to be supercooling and precipitation of the spheroidal-graphite/austenite envelope structure from the eutectic liquid.

It is not possible to draw any conclusions regarding the kind of nuclei which become operative at the eutectic temperature. A study of the inclusions present in magnesium-free and magnesium-containing irons, while very difficult to conduct, might yield interesting results.

No direct information has been obtained on the solidification shrinkage characteristics of magnesium-containing irons. Apart from the fact that spheroidal-graphite irons have a more dense appearance when viewed under the microscope, it is possible that magnesium removes gases, for example oxygen and nitrogen, the presence of which is believed normally to prevent full solidification contraction in flake-graphite irons.

CONCLUSIONS

The addition of magnesium to a cast iron of slightly hypoeutectic composition appears to have three main effects, although it is not known to what extent these are interdependent. They are:—

(*a*) Depression of the eutectic temperature, with an accompanying increase in the number of centres of eutectic crystallization.

(*b*) Change in the form of graphite particles to spheroidal, with a resulting essential change in growth mechanism, due to the formation of an austenite envelope around each spheroid.

(*c*) Increase in the tendency of the eutectic liquid to solidify as iron-carbide eutectic and a decrease in the tendency to form new graphite particles of any shape after the beginning of the eutectic reaction.

Inoculated flake-graphite and spheroidal-graphite cast irons appeared to have very similar solidification sequences; in each, the primary austenite dendrites appeared first, followed by the appearance and growth of crystallization centres in the liquid of highest carbon concentration, *i.e.*, at the liquid-solid interface. The centres then grew to replace the whole of the remaining liquid. When inoculation was omitted, this made a small difference to the structure of the flake-graphite iron of high-graphitizing tendency, and a very slightly decreased number of eutectic centres, each containing a slightly increased number of fine flakes, was observed. In the magnesium-containing iron, however, an appreciable decrease in the number of centres of eutectic crystallization was observed, and incomplete transformation of the liquid to graphite and austenite took

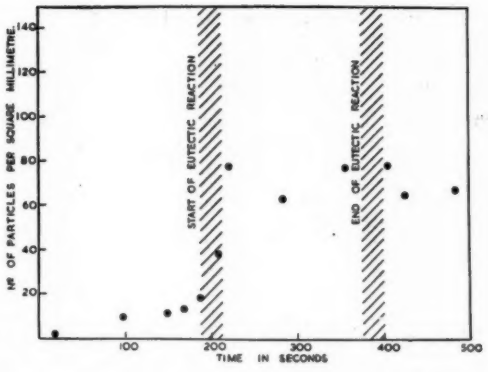


FIG. 14*a*.—*Graphite-particle Counts in Spheroidal-graphite Cast Iron Samples Quenched at Various Stages during Solidification.*

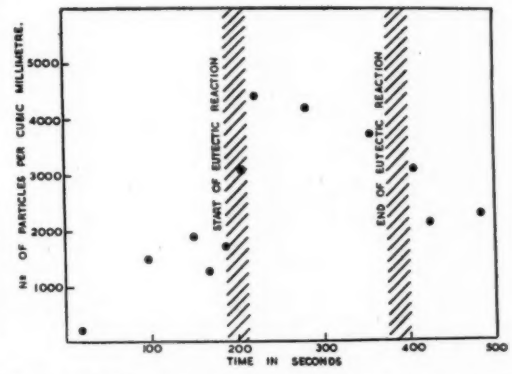


FIG. 14*b*.—*Graphite Particles per cub. mm. in Spheroidal-graphite Cast Iron Samples Quenched at various Stages during Solidification.*

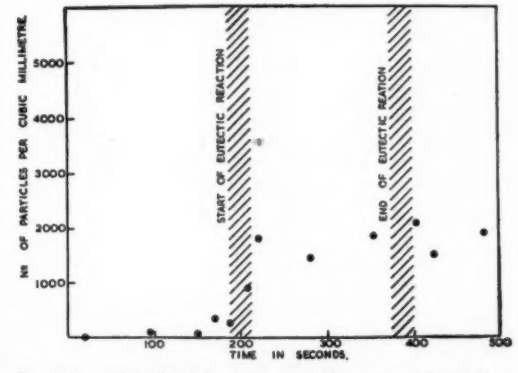


FIG. 14*c*.—*Graphite Particles per cub. mm. as Fig.* 14*b, but after Subtraction of the Number of Particles less than* 0.01 *mm. diameter.*

place, possibly partly because of the reduced number of graphite particles. The last liquid solidified as the austenite/iron-carbide eutectic, which represents the smallest redistribution of carbon atoms on solidification (assuming a random distribution in the liquid). Some of this carbide probably graphitized subsequently. Possibly because of uneven diffusion of carbon, the spheroids assumed an irregular outline during growth.

These conclusions may not be of general application, and much remains to be learned about the effects of composition changes, of other spheroidizing elements, of interfering elements, and of inoculation, before the full mechanism of spheroidal-graphite formation is established. The findings are broadly in agreement with the conclusions of Dunphy and Pellini, but they differ in detail; for example, it has been shown that in inoculated magnesium-containing irons the last liquid solidifies directly as austenite and graphite and that the solidification of the iron-carbide eutectic, with subsequent rapid graphitization, occurs only when inoculation is omitted.

Acknowledgment

The Author is indebted to the Mond Nickel Company, Limited, for permission to publish this Paper. He also wishes to express his appreciation of the advice and constant encouragement received from Mr. H. W. G. Hignett, superintendent of the company's Birmingham laboratory, and to acknowledge his indebtedness to colleagues for their assistance in his experiments.

DISCUSSION

Opening the discussion the CHAIRMAN (Mr. E. Longden) said, although the Author had apologized for the academic nature of the Paper, he could assure him that most of the members present looked forward to hearing of the experiments and research that were being carried on, and they had learned with interest of the steps being taken to understand the mechanism of the formation of graphite. There was an increasing volume of information being built up as a result of the discovery of nodular cast iron, as it was termed by those who developed it by the cerium process, or spheroidal cast iron as it was termed when produced by the magnesium process.

MR. H. MORROGH said the problems associated with the solidification of nodular cast iron and the formation of nodular or spherulitic graphite had been clouded by a rush of theories during the last two or three years. It was refreshing to find an investigator prepared to remain within the province of his experimentally-determined observations. His analysis of the theories which had been propounded to explain spherulitic graphite formation constituted a very fair and lucid statement.

With regard to the linear arrangement of the nodules which occurred, as the Author suggested, because of their distribution around the dendrites, he wondered if he had observed any effect of pouring temperature on that arrangement. The higher the pouring temperature the more columnar was the primary structure of the cast iron, as had been shown by Norbury, and therefore high pouring temperatures might favour the linear arrangement of the nodules.

Effect of Tin

The Author said tin hindered the formation of nodular graphite and had found up to 0.13 per cent. tin to be without harmful effect on spherulitic graphite formation in the absence of other subversive elements. Could the Author say what percentage of tin he had found to have a harmful effect? In connection with the non-inoculated magnesium-containing irons, the Author stated the carbon had apparently diffused to the spherulites in an irregular manner giving an imperfect outline, and then he said that effect was greater than could be explained solely on the basis of the reduced number of nodules. By what procedure did he arrive at that decision?

The Author stated spheroidal-graphite irons had a more dense appearance under the microscope than flake-graphite irons. Did he mean that he saw many cavities in flake-graphite irons and not in nodular cast irons, even when by all accepted standards his samples were sound? He went on to suggest that oxygen and nitrogen might prevent the realization of full solidification contraction in flake-graphite irons, but since those gases were removed from magnesium-containing irons, the full contraction was experienced. It should be possible to check that by density determinations of nodular irons and other irons of the same nominal analysis and annealed to the same matrix structure using apparently sound samples cut, say, from a keel-block bar. If the Author's theory were correct, the

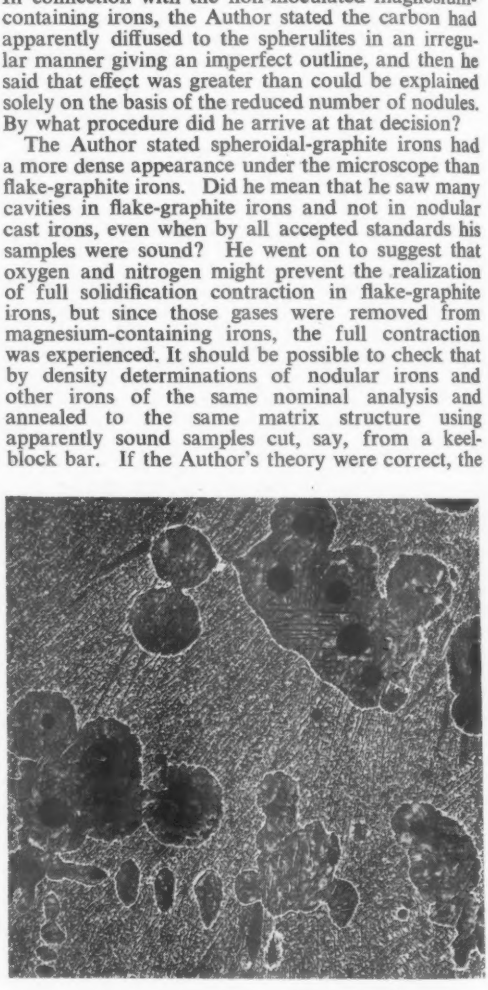


FIG. A.—*Section from the Lower Part of a Cooling Curve Ingot of Hyper-eutectic Magnesium-treated Iron, from which a Substantial Flotation of Hyper-eutectic Graphite has occurred. Etched,* ×100 *mags.*

densities should be in proportion to their respective casting contractions. Had that been tried?

Solidification Sequence

It could be concluded, he believed, that the picture of the solidification sequence in inoculated hypo-eutectic magnesium-containing iron was a primary deposition of austenitic dendrites followed by a simultaneous deposition of graphite in nodular formation and austenite which formed an envelope around the graphite nodule. The growth of the nodule took place by diffusion of carbon from the liquid to the nodule with a corresponding increase of the size of the austenite envelope. He concluded that a similar process occurred in magnesium-containing irons which were not inoculated, but due to the fewer centres of crystallization some portion of the eutectic solidified as austenite/iron carbide, which might graphitize after solidification. He suggested there was no fundamental difference between non-inoculated and inoculated magnesium-containing irons. Each nodule present during the beginning of the eutectic transformation appeared to have a certain sphere of influence within which solidification proceeded according to the Author's picture and outside which solidification took place with the formation of the austenite/cementite eutectic. When sufficient nodules were present at the beginning of solidification, so that their spheres of influence overlapped, then the whole of the eutectic crystallized as described by the Author, but when insufficient nodules were present to give that overlapping, some of the eutectic most remote from the nodules might transform to the austenite/cementite eutectic. The number of nodules could vary according to the efficacy of the inoculation, the cooling rate, and the degree of flotation of hyper-eutectic nodules in hyper-eutectic alloys. The latter point could be easily demonstrated. Fig. A showed the lower part of a cooling-curve ingot in a hyper-eutectic magnesium-treated iron, from which a substantial flotation of hyper-eutectic graphite had occurred. That ingot was quenched immediately following the termination of eutectic crystallization. A substantial amount of carbidic eutectic could be seen, although the few spherulites had austenite envelopes surrounding them. Fig. B showed the structure at the top of the same ingot, where there was a quite considerable concentration of graphite nodules, somewhat damaged in the flotation process, and it could be seen that the amount of eutectic carbide was very much less. He thought therefore that Mr. Hughes' distinction between inoculated and non-inoculated irons applied to the particular combination of type of iron, super-heat temperature, degree of inoculation and cooling which had been used.

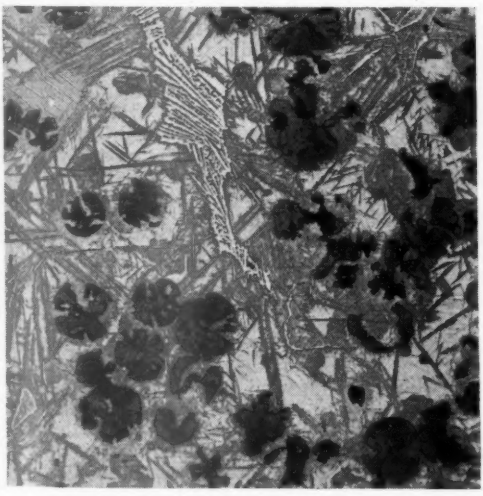


FIG. B.—*Section from the Top of the Same Ingot as in Fig. A, showing a Concentration of Graphite Nodules, some damaged in the Flotation Process. Etched,* ×100 *mags.*

Quench Effects

The investigator found in the inoculated, magnesium-containing irons some nodules, even in metal quenched from above the primary arrest point, and also somewhat larger nodules in samples quenched during the deposition of the primary austenite, that was, before the eutectic transformation had begun. Mr. Hughes cautiously omitted reference to that in his concluding remarks, perhaps because he felt that those nodules might be formed during the quench. It was, however, significant perhaps that the nodules were larger in the sample quenched from the lower temperature. Keverian, Adam and Taylor,[1] and Dunphy and Pellini had also found evidence of such nodules existing prior to the eutectic solidification in hypo-eutectic iron. It was most important for a future understanding of the mechanism of solidification of nodular irons that it should be settled whether those nodules formed during the quench or whether they actually existed in the liquid at the time of quenching.

One reason why he attached so much importance to that point followed from his results obtained carrying out similar experiments to those of Mr. Hughes on hyper-eutectic irons. He had found the solidification sequences to be, first hyper-eutectic nodules formed in the liquid, then austenite as an envelope around the hyper-eutectic nodules and as dendrites at points remote from the hyper-eutectic nodules (that deposition of austenite being accompanied by a pronounced inflection of the cooling curve) and then eutectic transformation proceeded either by the deposition of graphite on the already-existing nodules, or by the formation of the austenite/carbide eutectic, according to the number of hyper-eutectic nodules. It might be, if the nodules observed by Mr. Hughes and others in hypo-eutectic irons quenched from above the eutectic transformation represented a deposition of graphite from the liquid, that they had a solidification sequence analogous to that occurring in hyper-eutectic alloys, that was, a deposition of one primary phase followed by

[1] Amer. Foundrymen's Soc., 1952, Preprint No. 52-63.

the deposition of the other primary phase, followed by a simultaneous deposition of both, or the crystallization of the carbidic eutectic. Alternatively, it might be that the inoculation of hypo-eutectic iron caused local concentrations of silicon with precipitation of hyper-eutectic graphite in spherulitic form, which did not re-dissolve in the melt.

In view of the importance of the above consideration, he would like to have Mr. Hughes' opinion as to the origin of the nodules in the samples quenched during the deposition of primary austenite.

MR. HUGHES, replying, said in a field of that type it was essential to have as many comments as possible from people who were competent to point out the many significant factors in that work, and, as Mr. Morrogh rightly said, it was those factors which were so important to their understanding of the mechanism of the formation of graphite structures.

First, as to the effect of pouring temperature on columnar or otherwise crystalline form of the austenite, he was in agreement that high pouring temperature did give a more columnar structure to the crystals, but unfortunately he had not done any work on that and so could not help Mr. Morrogh in the matter. So far, he had carried out his experiments entirely using one range of super-heat.

Trace Elements

Mr. Morrogh touched on the effect of tin on the formation of spheroids. This was a part of the vast subject comprising the effect of elements in opposing, hindering or modifying the production of spheroidal graphite by magnesium. There were a number of those elements which had already been given much attention in the literature and in particular he would draw attention to a paper given to the International Foundry Congress in which Mr. Morrogh discussed at some length the effect of those elements. He would not like at the moment to state a definite figure because, if he did so, it might be at variance with the results of Mr. Morrogh. The reason for that lay to a large extent in the composition of the base iron. The metallurgy of this material was to-day rapidly becoming the metallurgy of the trace elements in cast iron, as a very small amount of these could to a great extent affect the amount of tin allowable before the structure was very much upset, but the effect of tin began at quite low levels. In certain irons quite an effect might be obtained at 0.01 per cent. of tin if the iron was impure, but in the complete absence of some of the other trace elements one would need considerably more tin to have appreciable effect. Interfering elements, again, could be the subject of a considerable series of experiments of the same type as those which he had reported. If one could understand in what way these elements affected the solidification of spheroidal-graphite cast iron, a powerful weapon would be available in determining how best to offset them. As Mr. Morrogh had already said in his American paper, one could now offset some of those elements to quite a remarkable extent.

Inoculation Mechanism

Regarding the reduced number of nodules and their effect on the structure of the non-inoculated irons, Mr. Morrogh had suggested that each spheroid had a limited region round it in which it could influence the solidifying liquid to yield the iron/graphite eutectic. He thought that was so, but he believed from the experiments he had done on the non-inoculated irons in the range of composition which he had used, that that fact alone would not explain the increased iron-carbide stability. In fact, the decrease in number of spheroids was small; the number was probably reduced by not more than 10 per cent.; whereas he had about 1,800 centres of crystallization in the inoculated iron, he had about 1,650 to 1,700 in the non-inoculated condition.

As far as the irregular graphite precipitation was concerned, he felt that if diffusion of the carbon were hindered in some way in a non-inoculated iron, then diffusion of carbon might become the limiting factor in the rate of graphite growth. Spheroids were growing close to the austenitic dendrites and the diffusion rate might well be different in austenite formed at different stages of solidification, giving rise to irregular growth. This was only a speculation at the present stage.

Voids

Mr. Morrogh had asked if he thought flake-graphite irons were porous. He had not meant to imply this. He was meaning that coarser flake-graphite irons had a structure sometimes known as an open structure—that was to say, they sometimes had the appearance of a lack of cohesion of the graphite and matrix, as compared with spheroidal-graphite irons; this was particularly apparent on machining and in polishing microstructures. He was suggesting that it might be that there were, in fact, microscopic voids between the flake graphite and the austenite, in some cases due to a lack of fit, which might in itself be quite a measurable proportion of the volume of the iron. He regretted that he was not able to produce any experimental evidence.

Other points to which Mr. Morrogh had drawn attention were the variables of flotation and various degrees of inoculation. He could only say he definitely agreed with Mr. Morrogh that those variables needed to be investigated, and he merely emphasized the fact that the number of variables was so large that any investigator working in that field had very little hope of rapidly assessing them all.

Finally, concerning the numbers of very small spheroids found in quenched samples. He had found very small spheroids in his quenched samples of all types of iron, but the number of them and the ease with which they might be found was greatly reduced in the non-inoculated irons. He could only think that one would have to carry out further experiments if one was to say with any degree of certainty whether those spheroids originated during quenching or not. The fact that inoculation might increase the number of these graphite spheroids was in keeping with the idea that inoculation precipitated in the liquid some form of graphite particles. It was not unreasonable, he thought, that some of those

particles might be spheroidal in form. In fact, he had suggested that it might be possible that flake graphite itself could grow from a spheroidal-type nucleus. If, however, all spheroids originated in the liquid at an early stage, it must be explained why in magnesium-containing irons their growth was suppressed at the normal solidification temperature of flake graphite.

The spheroids found in samples quenched from above the eutectic temperature increased in size with decreasing quenching temperature. This, Mr. Morrogh had suggested, might be due to their growth in the liquid state. In fact, there might be other explanations. The number of spheroids detected in the liquid before the eutectic precipitation was comparatively small, and the percentage of graphite involved almost insignificant. The lower the quenching temperature, the more slowly did the samples cool through the eutectic range, and it was probable that some graphite would be precipitated in this range even during quenching.

Interfacial Energy

MR. FLEMING said some time ago, when reading some American work, he had noticed a suggestion that the type of graphite depended on alterations in the surface forces occurring between the liquid cast iron and the graphite changing the suspension. That seemed to justify the comments Mr. Morrogh had made on the Paper, and to have some possible bearing on the subject, because if the spheroids originated in the liquid prior to the later phases occurring, such an explanation would fit both the hypo- and the hyper-eutectic irons. Had Mr. Hughes any views on that?

MR. HUGHES said Mr. Fleming had touched on a subject which he thought might be of great importance. The idea that interfacial energy might affect the formation of graphite, he thought, was first elucidated by Thall and Chalmers to the Institute of Metals at the end of a paper on the modification of aluminium alloys, and they proposed that by altering the surface tension one could reduce the form of the eutectic from the coarse lamellar type to the fine type. That seemed to have possibilities, but he did not at present think there was much relation between the modification of aluminium alloys and the production of spheroidal graphite, although there might be a comparison between the modification of aluminium alloys and the production of Type D, or under-cooled graphite. That should not be confused in any way with the production of spheroidal graphite, as it had in the past been confused to some extent. They were, in fact, dealing with a graphite form different from under-cooled graphite, but that did not mean to say, of course, that its formation was not still possibly a function of surface energy, either in the liquid or in the solid state. After all, a very small amount of magnesium was having an effect out of all proportion to its content in the iron.

Buttner, Taylor and Wulff had demonstrated the effect of magnesium additions to a high-sulphur iron melted in a graphite crucible *in vacuo*. The addition of magnesium had increased the surface tension of the liquid. However, this result would not explain why high sulphur alone could produce a few spheroids and it was doubtful whether their results were of general application to spheroid formation. He hoped that eventually someone would be able to prove whether, in fact, the change in graphite form from flake to spheroidal was a function of interfacial energy. However, it was an easy subject to talk about, but a very difficult one to prove.

The CHAIRMAN, closing the discussion, congratulated Mr. Hughes on getting over a difficult subject in a manner which made it possible for ordinary people to understand it. He asked the members to accord the lecturer a hearty vote of thanks.

Allied Ironfounders' Australian Subsidiary

The directors of Allied Ironfounders, Limited, have announced the registration in Victoria, Australia, of a wholly-owned subsidiary company under the name of Allied Ironfounders Proprietary, Limited, with a nominal capital of £1,000,000. Land has been acquired near Melbourne for the erection of a works which will include a fully mechanized foundry with modern equipment for ancillary and finishing processes. The company will manufacture in Australia, cookers, various heating stoves, and domestic hot water boilers.

Mr. W. T. Wren, assistant managing director of Allied Ironfounders, Limited, is chairman of the new company, with Sir John Storey, a leading Australian industrialist, as deputy chairman. They will be supported by management executives from the parent company.

Shareholders in the Alquife Ore Company, Limited, which was formed to take over the one-time subsidiary of Millom & Askam Hematite Iron Company, Limited, Millom (Cumberland), have been informed that the directors have received an approach for the purchase of the company's mines in Spain.

Manganese Ore Deposits in Brazil

An important deposit of manganese ore in the Urucun area of the Mato Grosso, Brazil, is to be exploited for export to the United States. The development of the deposit has been entrusted to a Brazilian company, which estimates that an investment of $35,000,000 will be required before shipments can be begun. The company has an agreement with an American steel company for the sale of all the ore extracted.

With a manganese content of 45.6 per cent., the ore is one of the richest in the world. In the same area there are deposits of hematite iron ore estimated at 1,300,000,000 tons with an Fe content of 55 per cent.

The Cement Makers' Federation has announced a further reduction in cement prices—the third in four months—which was effective from October 1. The price of cement packed in paper bags is reduced by 3s. a ton. Prices vary throughout Britain according to location. The Central London price is reduced to 91s. Cement delivered in bulk or in returnable packages is not affected. The latest cut is due to lower prices for paper bags. There has been a total reduction of 8s. 9d. a ton from the year's highest level.

Asia's Mineral Production

Mineral production in Asia and the Far East showed substantial increases in 1951. A comprehensive report issued by the United Nations Economic Commission for Asia and the Far East states that, in comparison with 1950, this region produced about 10,000,000 more tons of coal in 1951 and (excluding China) 700,000 more tons of iron ore. The region also benefited considerably from the high prices prevailing during the year of several minerals in the production of which is occupies a unique position. Malaya, Indonesia, and Thailand contributed about 59 per cent. of the total tin-ore production of the world in 1951. The region's dominant position in the world market of such export minerals as ilmenite (from India), tungsten ore (from China), graphite (from Ceylon), mica (from India), and manganese ore (from India) remained unchallenged.

Iron Ore and Ferrous Metals

The region, excluding China, produced 5,784,939 tons of iron ore in 1951, compared with 5,096,655 in 1950. There was a sharp increase in production in the Philippines and the Federation of Malaya, which exported almost their entire output to Japan. Table I gives the figures for 1951 and 1950 for comparison.

The trade situation remained unchanged. Hongkong, Malaya, and the Philippines exported iron ores to meet the demands of the Japanese iron and steel industry. Japan's need of iron ore is great. China and India produced iron ores for the requirements of their own iron and steel industries and India exported a small quantity to Japan.

TABLE I.—*Iron-ore Production of the Region, Excluding China.*

—	1951.	1950.
	Tons.	Tons.
Malaya	846,803	498,903
Hongkong	144,000	168,000
India	3,000,000	3,000,000
Japan	885,377	828,000
Phillippines	903,282	599,095
Thailand	6,477	2,657
Total	5,785,939	5,096,655

China has been and is the leading biggest producer of tungsten ore in the world, and the United States the biggest consumer. With the diversion of Chinese tungsten supplies to the U.S.S.R., and since the outbreak of hostilities in Korea, the price of tungsten has risen considerably.

India continued to be the world's most important producer of ilmenite and dominated the suppliers in the United States. New deposits have been discovered in Bombay which may strengthen India's position as a producer of ilmenite. Malayan production in 1951 was almost double that of 1950. Ceylon is planning to separate ilmenite and rutile from the beach sands.

The Philippines continued to be the leading chromite producer of the region, principally for export to the United States. Pakistan was the next largest, producing about 18,000 tons during the year.

India continued to be the principal manganese producer of the region, with the United States as its biggest consumer. Of the total imports of manganese ore into the United States in 1951, about one-third came from India.

Non-ferrous Metals

Japan continued to be the leading producer as well as consumer of copper, lead, and zinc in the region, with the Philippines as the second largest producer of copper. In Burma, the famous Bawdwin lead and zinc mines became a joint enterprize of the Government and the Burma Corporation, Limited, by the end of the year, but production remained low.

In spite of rising costs, labour difficulties, lack of security in mining areas and a decline of prices in the latter part of the year, the tin production of this region remained at about the same level as in 1950. Three important producing countries of the region, Malaya, Indonesia, and Thailand, contributed about 59 per cent. of the total world production (excluding U.S.S.R.) in 1951.

Japan, China, and India, following the order of importance, were the only three countries in the region producing aluminium in metal form. Production increased in 1951. Indonesia and India continued to be important producers of bauxite ore, the former entirely for export and the latter for its own aluminium industry. New deposits have been discovered in India.

Schools and the Ironfoundry

Complete success attended a visit to their works on September 11 arranged by the Stanton Ironworks Company, Limited, in conjunction with the Public Schools Appointments Bureau. The object of the visit was to give careers masters of a number of schools an insight into the prospect of a satisfactory vocation for boys of a type who would look to their efforts to provide them ultimately with technical or other higher executive positions. The party—masters from 21 leading schools and two officials of the Bureau—were welcomed by the Company's assistant managing director, Mr. Arthur Watson. They heard brief addresses on the service of the ironfoundry to the community from the director of the Council of Ironfoundry Associations, Mr. Kenneth Marshall, and on the training facilities in the industry and at the National Foundry College from the chairman of the development panel, Mr. S. H. Russell, and Mr. W. S. Matthews, the Stanton training officer. After seeing a film on the manufacture of Stanton spun iron pipes and making a tour of the Training Centre, they visited a spun iron pipe plant and were afterwards entertained to tea. There can be no doubt of the broadening effect of the visit in influencing the schoolmasters' outlook upon the ironfounding industry as a career for the modern public schoolboy. Stanton is to be congratulated on an effective step to encourage the recruitment of a good type of young man to the industry.

Mr. James Hay, the education officer of W. & T. Avery, Limited, Smethwick, is having some success in breaking down the reluctance of boys to enter the foundry industry. Old-fashioned prejudice that the industry is dirty, dangerous, and menial, has been one of the reasons causing a severe shortage of apprentices. "We have got to get this idea out of people's heads—particularly the parents of boys who want to enter the foundry industry," said Mr. Hay, adding that mothers should be told that it is an ancient and honourable craft, and a basic industry upon which the engineering industry depends. Mr. Hay's recruiting campaign has so far attracted to Avery's a public schoolboy from Wrekin College, and four secondary schoolboys. They are issued free with working clothes, and are given awards for examinations, and opportunities to attend training centres; shower-baths and other amenities have also been provided.

A PETITION for the erection of a £14,690 foundry building at Heathfield—the first project on a new site designated by Ayr Town Council for industrial development—was granted by Ayr Dean of Guild Court on September 26.

Brassfoundry Finishing Methods*

Discussion of Mr. F. Wild's Paper

MR. EDGAR N. HILEY (secretary, National Brassfoundry Association) wondered whether Mr. Wild had any experience of a degreasant known as Basol, which he had found for straightforward degreasing work, as distinct from the penetration into the inside of an article, was in every way as satisfactory as trichlorethylene. It was about one-twenty-fifth of the cost, safer because it was non-toxic and non-inflammable, and it did not need any special plant, although it could be used in a trichlorethylene plant.

During the shortage of brass, he had found a number of firms making prohibited articles of aluminium as a substitute and trying alternatives to anodizing, such as lacquering, but he believed that was not a very durable process and wondered whether the Author had any ideas on the subject.

MR. WILD, in reply, said Basol was an emulsion-type cleaner. There were two main types of emulsion cleaners on the market, one was a mild cleaner incorporating a wetting agent, and for certain applications it was quite good, being of the single-stage type such as Basol. The other type had a basis of white spirit, which would probably be better for getting into the inside of articles.

With regard to finishes for aluminium, he had seen it brass plated and then finished to make it look like brass, and he had also seen a considerable amount of steel finished as brass. When it came to lacquering aluminium over its natural colour, one of the troubles was it needed a certain degree of etching. It was essential that the metal should be freshly polished and degreased, otherwise an oxide film was formed on standing in the air and the lacquer would eventually strip off. While some firms were lacquering aluminium quite satisfactorily, the best thing to do was to get into touch with one's lacquer or paint supplier, who would doubtless provide details of application to aluminium.

MR. WILSON remarked that early in his lecture the Author had mentioned what he would term "jig barrelling," or fixing articles to a jig in a barrel. He understood that one of the machine-tool makers in this country had tried out the process unsuccessfully on plumbers' fittings. Had Mr. Wild learned in the United States of any manufacturer using the process for this class of work?

MR. WILD replied that he had not seen the process used in America on plumbers' fittings, but it should be borne in mind that it was not just a case of putting an article into a barrel and revolving it. The question of barrel speed, the way it was jigged, the abrasive, and even the temperature all made considerable difference.

Need for Development

MR. E. C. MANTLE, referring to alternatives to nickel plating, pointed out that many were really only in the experimental stage as regards performance, and it was very important, particularly in the case of export business, that one should be quite certain that these methods were really satisfactory and that a product was not being put out which would fail in service and would thus get our export trade a bad name. At the British Non-Ferrous Metals Research Association, they were at the moment carrying out very extensive tests on alternative finishes in order to assess performance under different conditions, and he knew Mr. Wild's firm was collaborating in that work.

MR. WILD agreed; in the finishing trade, everyone was "sitting on the fence," waiting to see which was the best alternative plating procedure, but it should be emphasized that as yet there was nothing as good as nickel. Whilst several methods were past the laboratory experimental stage, they were in a development stage as regards production and service life.

MR. BUTTERWORTH said his firm had been asked to produce some articles from copper sheet and to provide them nickel-plated, which they had been able to do successfully in the past but were now unable to do; had Mr. Wild any suggestions to offer as to an alternative? Cadmium had been suggested and they had tried it, but had found that, when working the copper sheet, subsequently there was some stripping, and in addition they did not know anything, as yet, about its corrosion resistance.

MR. WILD replied that without much more knowledge of the corrosive conditions under which the articles were required to operate he could not offer any advice. If Mr. Butterworth cared to let the Association have full details, experiments could undoubtedly be carried out.

Nickel Shortage Foreseen

MR. PARNELL asked whether any results had been obtained on finishes which could be applied to a plain surface and then afterwards deformed.

MR. WILD said a firm in Birmingham supplied nickel-plated sheet which was being used for the manufacture of articles of a quite awkward shape. He had not yet seen an alternative to nickel, and the question was still in its infancy. During the visit to the United States he had talked to several people in the plating plants about the nickel shortage, and from their general remarks it seemed that they were all aware there would be such a shortage about two years before it actually happened, and in many cases they had sufficient nickel in stock to carry on for some time.

* Paper presented to the Brassfoundry Productivity Conference and printed in the JOURNAL, October 2.

Brassfoundry Finishing Methods—Discussion

MR. HILEY said that some of the members of his Association had been making steel mantle-rails for shops and these were now subject to the prohibition on nickel plating. He would welcome Mr. Wild's comments on an alternative finish for indoor use only, but having regard to the friction imposed in service.

MR. WILD, in reply, said that the friction problem could be overcome by the use of a synthetic stoving lacquer which was exceptionally hard. A cellulose-base lacquer would not give sufficient wear resistance. The rate of deposition of brass from a plating solution was rather slow and, prior to the nickel ban, the practice had been to nickel plate to sufficient thickness to give good corrosion resistance and then plate a thin brass coating on top.

Research on the Constitution of Alloys

Several significant gaps in current research on alloy constitutions are commented on in a statement by B.I.S.R.A's Constitution of Alloys Group presided over by Professor G. V. Raynor. The group also indicates some ways in which it is willing to help fill the gaps. In calling attention to these possible lines of research, the group emphasizes its desire to encourage new and existing work on the subject of the constitution of alloys. It is prepared to suggest systems requiring investigation, and to put enquirers in touch with other workers in the same or similar fields. In particular cases, where the results of such work are likely to be of direct interest to the iron and steel industry, the group is able to make recommendations for some financial assistance. The group would also be glad to know of existing equilibrium-diagram work which has not been reported to them, and of projected research programmes involving the constitution of alloys. Those interested should communicate with the Secretary, Constitution of Alloys Group, British Iron and Steel Research Association, 11, Park Lane, London, W.1.

Meanwhile, the gaps in ferrous research work that the group's reviews have indicated can be summarized as follows: Although there appears to be no obvious gap in research work on high-temperature materials, a greater effort might well be expended in this field. It is also felt that certain systematic work in the binary alloys of iron, would be of value, both from the theoretical point of view and to serve as a basis for studies of the complex equilibria involved in ternary and quaternary alloys. Further, the relationships between the various carbides present in alloy steels offers a wide field. On the general theoretical side, it appears to the group that the contribution made by those interested in the determination of the crystal structures of intermetallic phases and in accurate lattice spacing measurements are of much importance, and that greater effort in this field would be appropriate. Further problems connected with the theory of metals and alloys arise in the purely physical field (*e.g.*, X-ray emission and absorption experiments on alloys, magnetic properties, low-temperature specific heats) and a more intimate contact between the physicist and the metallurgist interested in the general theory of alloys would be an advantage.

Short-article Competition.—First prize of £15 has been awarded to Mr. F. J. McCulloch in the short-article competition organized in "Foundry Practice," the house organ of Foundry Services, Limited. Mr. F. J. Timbrell has won the second prize of £10.

Evaluation of Blast-furnace Coke

Recommendations of U.S. Committee

While irregular blast-furnace operation can be due to causes lying outside the realm of coke quality control, other causes could include a failure to maintain a regular charging schedule, faultily designed or an inadequate plant and inadequate or improper preparation of the burden. Since, however, coke occupies some 60 per cent. of the furnace volume, the necessity for the maintenance of a uniform quality of coke is stressed by R. W. CAMPBELL in a paper on "A Study of Tests for the Evaluation of Coke," presented to the American Iron and Steel Institute. It is based on the report of the Evaluation Committee of the Coke Evaluation Project which investigated the matter.

Coke-testing Procedure

One of the principal objectives of the coke evaluation project was to determine which of the commonly applied coke tests overlapped or paralleled each other. The investigation revealed several instances of significance. Thus, in determining the correlations between the 2-in. screen index of coke and the other factors no significant difference was found when the 3-in. screen index of coke was substituted. The important point is that there is a direct and predictable relationship between the various screen fractions of a particular coke. The correlation factor between the 2-in. screen index and the 2-in. shatter index of coke was found to be 0.98, and when the 3-in. screen index was substituted for the 2-in. screen index the factor was found to be 0.91, either one of which indicates that these factors, the 2-in. screen index and the 2-in. shatter index, indicate exactly the same thing with respect to measuring coke strength. In comparing the 2-in. screen index with the tumbler stability index (plus 1-in. coke) a correlation factor of 0.86 was obtained, which again indicates that the 2-in. screen test and the tumbler stability give exactly the same information. Table I shows the coke tests eliminated and those recommended.

TABLE I.—*Coke Tests Eliminated and Recommended by the Evaluation Committee.*

Tests eliminated.	Tests recommended.
(1) Moisture (each screen fraction)	(1) Moisture (gross sample + 1-in. coke)
(2) Shatter, standard	(2) Volatile matter (+ 1-in. coke)
(3) Shatter, special	(3) Ash (+ 1-in. coke)
(4) Tumbler, standard	(4) Sulphur (+ 1-in. coke)
(5) Apparent sp. gr. (+ 1-in. coke)	(5) Screen (total per cent. plus 2 in.)
(6) True sp. gr. (+ 1-in. coke)	(6) Tumbler, special—hardness index (+ ¼ in. after 400 revolutions)
(7) Void volume (+ 1-in. coke)	(7) Bulk density (+ 1-in. coke)
(8) Air permeability (+ 1-in. coke)	
(9) Reactivity indices	

In spite of competition from Continental manufacturers, an order has been received by Leyland Motors, Limited, Leyland (Lancs), for 150 buses, each capable of seating 45 people, for Santiago, Chile. The order is worth about £1,000,000. The company has also obtained orders for lorries, buses, self-loading machines, and water tankers for Yugoslavia, Nigeria, Sweden, Turkey, South Africa, and the Middle East.

News in Brief

AN EXPORT ORDER worth £750,000 for high-speed paper-making plant for Finland has been received by Walmsleys (Bury), Limited.

AN ORDER from the Houlder Line for a tanker of 18,000 tons dw. has been received by R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-upon-Tyne.

THE MASTER AND MISTRESS CUTLER (Mr. and Mrs. G. M. Flather) visited the works and work's school of Newton Chambers & Company, Limited, Thorncliffe, on October 3.

A BLOCK incorporating showers, washbasins, and lockers at Westburn Foundry of Douglas Fraser & Sons, Limited, Arbroath, was opened on September 27 by Provost J. K. Moir.

AN 18TH-CENTURY MOULD for making lead bullets has been presented to Mr. A. W. Taylor, librarian of Tipton, for a museum he is forming to exhibit properties of local and historic interest.

AN INTERESTING TALK on the iron industry, and some details of the Stanton story, was given by Mr. R. Sharpe, superintendent of blast furnaces for the Stanton Ironworks group, to the Ilkeston Rotarians.

GERARD WAKEHAM, LIMITED, the Scottish representatives of Chamberlain Industries, Limited, have moved from their address at Carlton House, 26, Blythswood Square, Glasgow, C.2, to 1, Clifton Street, Glasgow, C.3.

MR. W. M. LARKE, general works manager of Stewarts and Lloyds, Limited, Bilston Works, last week re-opened the works swimming baths. These baths have been out of use since the outbreak of war in 1939.

THE DUKE OF DEVONSHIRE visited Sheffield recently and toured the works of the English Steel Corporation, Limited, where he saw armour plate being rolled. He was also taken round the works of G. Ibberson & Company, cutlery manufacturers.

AUSTRIAN PIG-IRON PRODUCTION in the period January to June totalled 605,490 tons, compared with 478,060 tons in the first six months of 1951. Crude steel production was 536,864 (495,402) tons and output of rolled products 361,492 (315,693) tons.

ABOUT 100 old boys who were past student-apprentices, and members of the Falcon Association, held a reunion at the Brush works, Loughborough. After tea they made a tour of the works. The Association's annual dinner was held at Leicester.

THE STEEL BAND CONVEYOR & ENGINEERING COMPANY, LIMITED, of Dawlish Road Works, Selly Oak, Birmingham, 29, has, with the approval of the Board of Trade, changed the name of the company to Sandvik Steel Band Conveyors, Limited.

THE CONTRACT for the propelling machinery for a 10,000-ton cargo ship ordered from Short Bros., Limited, Sunderland, by the Thomasson Shipping Company, Limited, London, has been secured by Swan, Hunter & Wigham Richardson, Limited, Wallsend.

RUBERY OWEN, LIMITED, are to sell one of their major stands, cut down on sales staff, and withdraw their outside stands from the Birmingham section of the British Industries Fair because they believe the Fair has lost a great deal of interest in the past two years.

LAST MONDAY, Glasgow local Cleansing Department opened their drive for heavy types of household scrap, such as old bedsteads, fire-grates, mangles, etc., in an effort to help the foundry industry. An appeal is being made to all householders to co-operate and make available as much steel metal as possible.

A CARGO MOTORSHIP of 9,250 tons dw. has been ordered from Short Bros., Limited, Sunderland, by a Norwegian firm. The vessel will be fitted with a Diesel engine, developing 4,400 b.h.p., which will be supplied by John G. Kincaid & Company, Limited, Greenock.

ON THE OCCASION of their second annual "At Home" day, visitors to the Sheepbridge Group of Companies were able to make a tour of the foundries, blast furnaces, and engineering shops, and an informative survey of re-organization and developments which have been carried out under the direction of Mr. T. Brown (managing director) was given.

AT A COST of over £10,000, William Jessop & Sons, Limited, Brightside Works, Sheffield, have bought 9½ acres of land near Ecclesfield to be laid out as a private sports field for the firm's club, which has more than 2,000 members. Plans are also prepared for the building of a pavilion, dressing rooms, and other accommodation on the site.

MR. HAROLD GOODWIN, managing director of Birmetals, Limited, was among the 74 recipients of long-service awards presented to employees of Birmid Industries, Limited, on September 27. Mr. E. Carey-Hill, deputy chairman of Dartmouth Auto Castings, Limited, made the presentations, which were an illuminated certificate, a badge, and a chiming clock.

AT A DINNER on October 2 some two hundred members of the Inco Quarter Century Club of Henry Wiggin & Company, Limited, Birmingham, saw clocks, watches, brooches and buttons presented to new members of the club—employees with 25 yrs. or more service. The presentations were made by Mr. L. H. Cooper, chairman of the Mond Nickel Company, Limited.

AT AN INFORMAL CEREMONY which took place last week in the foundry canteen of Ferranti, Limited, Hollinwood, Lancs, Mr. R. Laroux Handley, departmental manager, made a presentation to Mr. J. Garlick, works manager, on behalf of all his many friends in the foundry. After 33 years' association with Ferranti, Limited, Mr. Garlick leaves to take up an appointment at Baker Perkins, Limited, Peterborough.

NEW PLANT for the production of sponge iron with a yearly capacity of 30,000 tons is to be built by the Grängesberg-Oxelösund Company, at Oxelösund, in central Sweden. It will employ the sponge-iron method developed by the Swedish Höganäs Company, and the works will be constructed in co-operation with that company. It is to be erected close to the Oxelösund pig-iron works, utilizing blast-furnace gas from these works for fuel. The production is intended mainly for the Swedish home market.

REPRESENTATIVES of the Federation of British Industries, the National Union of Manufacturers, Chambers of Commerce and Midland local authorities are to attend a conference in Birmingham to-day to discuss the problem of land development charges and their effect on industry, especially in relation to the smaller manufacturers. The conference is being held under the auspices of the Midland Industrial Development Association which is collating evidence of delay to industrial development caused by development charges. The Association has asked the parent body, the English National Council of Development Committees, to urge the Government to remove development charges on industrial land, or, pending their elimination, to introduce a standard system of payment by instalment. It is stated that many small industries, including foundries, have found it impossible to undertake normal expansion.

Imports and Exports of Iron and Steel in August

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in August. Figures for the same month in 1951 are given for the purposes of comparison and totals for the first eight months of 1952 and of 1951 are also included.

Exports of Iron and Steel by Destination (tons)

Destination.	Month ended August 31.		Eight months ended August 31.	
	1951.	1952.	1951.	1952.
Channel Islands	777	350	6,164	4,721
Gibraltar	130	115	523	1,345
Malta and Gozo	311	149	2,242	1,616
Cyprus	157	613	3,159	4,118
Sierra Leone	309	416	3,498	3,557
Gold Coast	1,304	3,287	12,156	23,502
Nigeria	3,202	1,556	37,653	29,563
Union of South Africa	8,463	10,854	89,163	95,279
Northern Rhodesia	676	1,661	9,565	19,174
Southern Rhodesia	2,623	4,984	25,518	37,991
Tanganyika	982	1,709	11,756	14,237
Kenya	2,625	2,476	35,249	27,816
Uganda	337	318	3,626	4,194
Mauritius	535	288	4,722	3,937
Bahrein, Qatar, and Trucial Oman	949	744	5,126	11,051
Kuwait		777		10,203
India	6,014	5,288	62,878	49,892
Pakistan	4,974	4,596	52,610	50,291
Malaya	6,166	6,511	50,596	52,588
Ceylon	1,426	1,222	18,797	15,551
North Borneo	137	95	3,529	2,420
Hongkong	1,734	2,603	39,975	15,484
Australia	23,111	25,729	228,328	207,935
New Zealand	6,032	11,270	68,864	97,306
Canada	25,630	10,778	175,193	123,763
Jamaica	3,278	1,767	13,177	18,968
Trinidad	4,210	2,925	26,702	31,340
British Guiana	289	340	3,857	4,124
Anglo-Egyptian Sudan	608	2,359	6,209	13,139
Other Commonwealth	2,191	1,869	15,799	21,581
Irish Republic	5,056	5,556	61,929	42,134
Soviet Union	—	—	2,236	1,037
Finland	3,033	2,722	24,588	36,816
Sweden	9,695	6,670	72,536	76,960
Norway	2,949	4,405	42,916	41,946
Iceland	227	131	1,971	2,138
Denmark	3,924	2,599	55,014	53,224
Poland	50	8	629	81
Germany	55	141	751	993
Netherlands	6,004	8,381	60,446	68,026
Belgium	785	577	8,238	5,557
France	221	210	4,178	1,676
Switzerland	397	556	7,899	6,225
Portugal	433	740	9,489	6,116
Spain	149	1,094	2,923	6,214
Italy	2,559	436	24,616	7,640
Austria	15	30	345	383
Yugoslavia	780	256	6,940	3,464
Greece	292	48	2,036	2,139
Turkey	194	140	3,900	5,393
Netherlands Antilles	1,579	4,292	5,222	11,408
Belgian Congo	196	101	1,598	1,992
Angola	72	88	1,601	2,332
Portuguese E. Africa	345	116	2,553	3,169
Canary Islands	56	19	1,430	530
Syria	1,441	253	4,396	1,713
Lebanon	827	161	9,171	7,983
Israel	2,285	805	21,460	10,535
Egypt	4,077	1,834	30,625	22,585
Morocco	21	8	1,334	183
Saudi Arabia	251	72	565	4,560
Iraq	3,736	3,902	17,464	34,357
Iran	3,789	258	56,232	6,765
Burma	982	523	9,345	8,050
Thailand	1,602	1,074	11,456	6,797
Indonesia	1,423	893	6,038	10,359
China	—	—	4,619	191
Philippine Republic	227	789	2,595	3,639
U.S.A.	11,601	6,522	120,365	34,708
Cuba	188	25	2,873	1,415
Colombia	1,982	79	5,885	2,903
Venezuela	8,777	4,210	31,660	27,746
Ecuador	181	483	947	2,872
Peru	343	744	8,794	5,947
Chile	216	128	5,937	2,398
Brazil	1,130	2,240	15,608	17,268
Uruguay	463	286	8,490	3,439
Argentina	3,067	2,979	31,455	26,843
Other foreign	1,839	2,040	12,772	15,075
TOTAL	198,694	177,273	1,842,704	1,642,610

Imports of Iron and Steel, and Origin (tons)

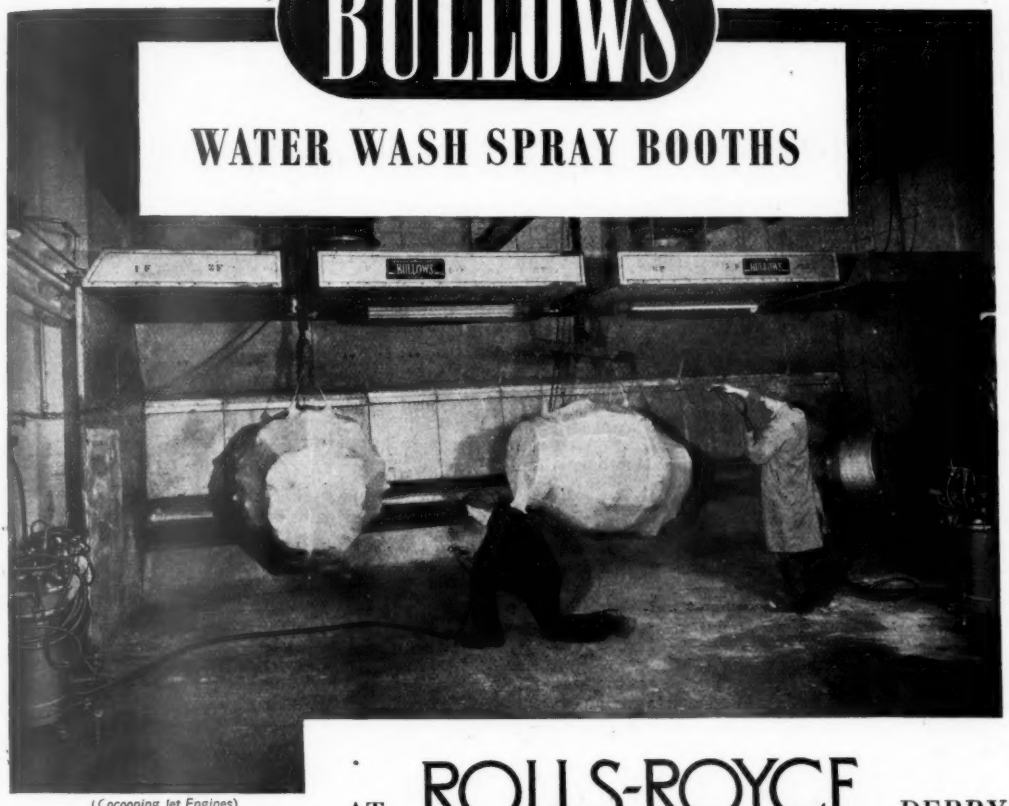
From	Month ended August 31.		Eight months ended August 31.	
	1951.	1952.	1951.	1952.
India	5	1	7	229
Canada	4,842	20,382	31,881	97,412
Other Commonwealth countries and the Irish Republic	100	912	1,059	3,726
Sweden	1,548	2,663	14,511	19,000
Norway	5,100	4,826	34,331	43,482
Germany	1,970	12,087	14,496	71,857
Netherlands	5,890	22,900	48,651	102,980
Belgium	16,406	23,133	113,478	208,042
Luxembourg	6,489	13,010	54,584	112,316
France	25,956	46,445	165,574	200,721
Austria	5,985	22,130	18,781	118,596
U.S.A.	3,456	47,199	23,702	426,692
Other foreign countries	1,296	27,398	3,151	166,685
TOTAL	79,043	243,086	524,206	1,571,738
Iron and steel scrap and waste, fit only for the recovery of metal	47,941	76,053	425,357	449,412

Exports of Iron and Steel by Group (tons)

Product.	Month ended August 31.		Eight months ended August 31.	
	1951.	1952.	1951.	1952.
Pig-iron	540	58	14,197	2,498
Ferro-tungsten	3	10	296	71
Other ferro-alloys	62	146	1,540	2,332
Ingots, blooms, billets, and slabs	121	38	5,030	161
Iron bars and rods	566	163	6,608	2,338
Steel and tinplate bars and wire rods	689	15	9,691	887
Bright steel bars	936	756	23,504	9,131
Alloy steel bars and rods	1,391	1,305	10,826	10,610
Other steel bars and rods	7,685	7,277	128,771	73,647
Angles, shapes, and sections	9,289	6,782	113,018	88,808
Castings and forgings	1,024	785	7,807	8,064
Girders, beams, joists, and pillars (rolled)	2,635	3,290	28,732	24,877
Hoop and strip	6,707	2,605	48,245	31,631
Iron plates and sheets	225	81	1,625	359
Tinplate	17,898	25,487	166,423	195,025
Tinned sheets	83	168	1,841	1,216
Terne plates and decorated tinplates	90	77	916	546
Other steel plate (¼ in. thick and over)	15,230	18,160	185,691	157,033
Galvanized sheets	3,529	2,901	36,566	40,330
Black sheets	11,230	10,807	103,262	88,407
Other coated plates and sheets	704	811	6,454	7,072
Cast-iron pipes up to 6 in. dia.	7,789	6,911	53,828	59,693
Do., over 6 in. dia.	7,296	5,650	48,610	45,469
Wrought-iron tubes	40,121	27,474	274,092	281,335
Railway material	12,452	20,041	158,203	140,329
Wire	4,220	2,814	40,962	34,322
Cable and rope	2,235	2,113	20,234	20,314
Wire nails, etc.	2,021	697	19,329	7,335
Other nails, tacks, etc.	790	341	6,954	4,115
Rivets and washers	551	340	4,820	4,169
Wood screws	356	267	2,594	2,937
Bolts, nuts, and metal screws	2,520	1,340	18,627	15,727
Baths	282	88	2,354	2,419
Anchors, etc.	718	587	6,004	6,561
Chains, etc.	858	877	7,537	7,120
Springs	399	387	4,241	4,109
Holloware	2,429	2,846	24,020	23,755
Doors and windows	1,690	1,533	13,790	14,579
TOTAL, including other manufactures not listed above	198,694	177,273	1,842,704	1,642,610

BULLOWS

WATER WASH SPRAY BOOTHS



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Personal

MR. A. SMART has been appointed a director of Electric Furnace Company, Limited, of Netherby, 161, Queens Road, Weybridge.

MR. J. R. MARTINDALE, divisional engineer to the Edinburgh division of the Scottish Gas Board, has been appointed chief engineer to the Wellington Gas Company, New Zealand.

MAJOR F. MONK, chief safety officer in this country of the Dunlop Rubber Company, Limited, has retired at the age of 65. He joined the company in 1918 and was appointed to his present post in 1949.

MR. J. H. MILLER-WHEELER has resigned as publicity manager of Drysdale & Company, Limited, pump manufacturers, Yoker, Glasgow, owing to ill-health, and will, meantime, undertake lighter duties in the firm's technical department.

MR. RICHARD PERKINS, deputy sales director for overseas countries of F. Perkins, Limited, Diesel engine manufacturers of Peterborough, left recently on a visit to South Africa, Australia, Canada, New Zealand and a number of other countries.

MR. PHILIP A. SINGLETON, acting managing director, has been appointed managing director of Monsanto Chemicals, Limited. DR. W. D. SCOTT is to be assistant to the chairman with particular responsibility for the co-ordination of the company's activities in the Commonwealth.

MR. JOHN E. MERCER, general manager and a director of Head, Wrightson & Company, Limited, Thornaby-on-Tees (Yorks), who is retiring, has received a presentation from workmen of the foundry and steel dressing department. His services are being retained by the company in a consultative capacity.

MR. JAMES A. GLASS, of Dalmellington, Ayrshire, flew from Prestwick Airport on Monday for Montreal to take up an appointment with the Dominion Bridge Company of Canada. He was on the staff of Glenfield & Kennedy, Limited, Kilmarnock, and holds the H.N.C. and is a graduate member of the Institution of Mechanical Engineers.

MR. C. E. PROSSER has been appointed deputy chairman of Imperial Chemical Industries, Limited, Metals Division, Witton, as from October 1. Mr. Prosser is succeeded as joint managing director, Metals Division, by MR. M. J. S. CLAPHAM, who was formerly I.C.I. Midland regional manager and a member of the Metals Division board.

AT THE ANNUAL MEETING of the British Shipbuilding Research Association the council of the association elected MR. J. RAMSAY GEBBIE, managing director of Wm. Doxford & Sons, Limited, and MR. CHARLES CONNELL, chairman of Charles Connell & Company, Limited, Scotstoun, Glasgow, as chairman and vice-chairman, respectively, of the council for the ensuing year.

AIR COMMODORE SIR FRANK WHITTLE, F.R.S., was presented with the Churchill Gold Medal of the Society of Engineers on Monday. The award has been approved by Mr. Winston Churchill, who is an Honorary Fellow of the Society of Engineers, and is made for the most noteworthy development in engineering or contribution to contemporary engineering. It is the first award made by the Society.

OWING to the pressure of his other commitments, SIR CHARLES GOODEVE, F.R.S., has resigned from the Scientific Advisory Council which was set up in 1948 to advise the Minister of Fuel and Power on the scientific aspect of his statutory duties. Sir Charles, who is director of the British Iron and Steel Research Association, served as Assistant and later Deputy Controller for Research and Development at the Admiralty from 1942 to 1945.

MR. W. J. VAUGHTON, a director of the Delta Metal Company, Limited, London, S.E.10, and assistant managing director of the company's Birmingham works, has been appointed to the boards of the company's three subsidiaries, Extruded Metal Company, Limited, London, S.E.10, Moore Bros. (Birmingham), Limited, and Heaton & Dugard, Limited, Birmingham. He became an assistant director of the Delta Metal Company early this year and a full director in June.

Obituary

MR. ROY HOWARTH SCHOFIELD, production controller of Platt Bros. & Company, Limited, textile engineers, of Oldham (Lancs), died from injuries sustained while playing rugby on September 27. He was 25.

DR. F. C. LEA, who retired from the board of Edgar Allen & Company, Limited, the Sheffield steelmakers, in 1950, has died at the age of 81. A former Dean of the Faculty of Engineering at Sheffield University, he was a past-president of the Institution of Mechanical Engineers.

DR. FREDERICK JOHNSON, who died on October 1 at the age of 70, was head of the Department of Metallurgy at Birmingham Technical College for 35 years. Dr. Johnson, who was an acknowledged authority on the heat-treatment of metals, was a past-president of the Metallurgical Society, of which he later became an honorary member. He was an original member of the Institute of Metals.

MR. WILLIAM BAIRD, who died suddenly at the age of 70 while out motoring with his brother, was chairman of the Scottish Ironmasters' Association and a well-known figure in the heavy industries of Lanarkshire. About 50 years ago he entered the firm of Wm. Baird & Company, coal and iron masters: At the time of his death he was vice-chairman of the firm and was actively connected with the firm's various subsidiary and associated companies.

British Standards Institution

Dimensions of Foundry Moulding Boxes (*B.S.* 1889-1952)

The purpose of this British Standard, which was prepared at the request of the Institute of British Foundrymen, is to provide a standard range of moulding boxes and their essential components for the foundry industry in order to increase interchangeability to reduce the excessive number of types at present in use and to aid designing, work planning and costing. It is realized that special-purpose boxes will, of necessity, still be required, but it is considered that in the majority of instances the range of sizes specified will satisfy the major requirements of the industry.

The standard specifies dimensions of 2-pin square, rectangular or round box parts, designed for loose pins, of sizes ranging from 12 by 12 by 3 in. to 72 by 72 by 24 in., with pin diameters ranging from ½ to 1¼ in. and distances between pin centres ranging from 15 in. to 77 in. It specifies also dimensions of lugs and bushes, which may be single or double. Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 24, Victoria Street, London, S.W.1, price 2s. 6d.

AMBERLITE '12' GRADE

High temperature rapid hardening insulating concrete for lining furnace doors, as foundation insulation in high temperature kilns and furnaces, construction of high temperature flues. Limiting service temperature 1200°C. (2192°F.).

AMBERLITE '43' GRADE

Normal hardening insulating concrete of high insulating value and good compressive strength, for furnace and boiler foundations. Limiting service temperature 871°C. (1600°F.)

AMBERLITE 'S43' GRADE

Similar to above but with rapid hardening bond for speedy construction. Eminently suitable for insulation of furnace hearths, bogie hearths, kiln cars, etc. Ideal for urgent repairs. Limiting service temperature 900°C. (1652°F.).

VERMICULITE 'V' STANDARD GRADE

Rapid hardening insulating concrete utilising expanded vermiculite as an aggregate. Very good results have been obtained with this concrete in the monolithic construction of gas fired annealing and heat treatment furnace arches and walls. Limiting service temperature 1000°C. (1832°F.).

VERMICULITE 'V' LIGHTWEIGHT GRADE

Similar to above but lightweight for jointless "back-up" insulation behind refractory linings. Limiting service temperature 1000°C. (1832°F.).

Further information relative to AMBERLITE INSULATING BRICKS, MORTAR and CEMENT, etc., and AMBEREX INSULATING SLABS and PLASTIC will be gladly furnished upon request.

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Raw Material Markets

Iron and Steel

Pig-iron production in September was at the record annual rate of 10,845,000 tons. It compares with a rate of 9,854,000 tons in the corresponding month of last year and the previous peak rate, reached in August of this year, of 10,498,000 tons. Steel production in September was at an annual rate of 17,141,000 tons. This compares with a rate of 15,749,000 tons in September of last year and exceeds the previous highest September, in 1950, when the rate was 16,964,000 tons. This new steel output record, the British Iron and Steel Federation states, was made possible by the expansion of pig-iron production.

In common with other industries, the foundry trade is feeling the effect of import restrictions abroad, which are accompanied by reduced requirements from some oversea buyers. There is also a decline in new business for castings on the home market, with the result that the volume of orders now reaching the foundries is less than it has been for some years. In the textile industry, for example, trade recession has actually resulted in unemployment. The light foundries producing castings for household equipment are now experiencing a marked decline in business, while many of the jobbing foundries have also to search for fresh orders to ensure continuity of production. The engineering and speciality foundries, which for so long were overloaded with work, are finding conditions easier, too. To offset the shortage of orders for their normal type of castings, many foundries are now engaged on work associated with rearmament. The outputs of castings so far has been fairly well maintained, but, unless there is an upsurge of both home and export business, production will inevitably fall away.

The major portion of current pig-iron output is going to swell the productive capacity of the steel industry. Six new blast furnaces recently blown in and two more due to be put into operation in the near future are all for the production of basic-steel making pig-iron, and they are going a long way to removing the difficulties caused to the steel industry by the scrap shortage. Even with reduced quantities of pig-iron going to the foundries, due largely to the cut in licensed tonnages, there is none too much available for their use. The engineering and speciality foundries are taking up all available tonnages of low- and medium-phosphorus iron and hematite, while the supply of high-phosphorus pig-iron for the light and jobbing foundries barely covers present needs. Parcels of Continental high-phosphorus pig-iron are on offer, but the foundries show little interest even with the reduction in price which has been made possible by the removal of the 25 per cent. import duty. If this concession had been made six or more months ago, it would have been far more helpful than it is today when the needs for this grade of pig-iron are so much reduced.

For some time past deliveries of foundry coke have been quite sufficient to meet current requirements, but the complaint has been fairly general that consumers were unable to build up stocks against the winter, when deliveries are subject to delay at times by inclement weather. Fortunately, coke arrivals have improved and many users are in possession of small reserves. In fact, some Lancashire foundries are reported to have reached the limit of their storage capacity.

Improvement in deliveries of steel semis from oversea continues, and the re-rollers are now in a much better position to cope with their commitments. Home steelworks are sending forward the tonnages they can spare, but there is need for the smaller sizes of billets and special quality steels. A good demand is made for light sections and bars from home consumers, but some report a slackening off due to reduced orders for machinery and equipment for export markets. Oversea business for light sections and bars is extremely quiet, and so long as there is such a wide divergence between our export prices and those of foreign producers, little improvement can be expected.

The sheet re-rollers are able promptly to dispose of all their output, which has expanded as a result of the larger tonnages of slabs and sheet bars received from abroad and improved supplies from home steelworks.

Non-ferrous Metals

It was a matter of great satisfaction to the trade that the reopening of the lead market passed off so well and that dealers seemed to get into their stride so quickly. The turnover during the two periods of dealing at midday on October 1 exceeded 4,000 tons, and after one deal had been put through on the basis of £111, values dropped away to close at £108 sellers, for all dates October to January. During the first market the Government broker sold a 25-ton lot of lead at £111, this metal being for immediate delivery. The premium of £3 aroused some comment as it was felt that, with so much lead on hand in the country, it seemed strange that a buyer should be obliged to pay so relatively dearly for spot metal. On the second day of dealings in lead there was a further setback in the quotation, which closed at £100 sellers and £99 10s. buyers. Friday saw a modest recovery to around £101 10s., while it was reported that some 200 tons of prompt metal had been sold at £102. In spite of this somewhat steadier trend, the prospects for lead do not seem to be very bright, and most people seem to think that we shall see the price lower during the coming weeks. In fact, there has been a steady decline this week. On the Continent the quotation has been lowered more or less in line with the level ruling in London.

Official prices for refined pig-lead for both October and January positions since free trading in the metal was resumed were as follow:—October 1, £107 10s. to £108; October 2, £99 15s. to £100; October 3, £101 5s. to £101 10s.; October 6, £99 10s. to £100; October 7, £98 to £98 5s.; October 8, £91 5s. to £91 10s.

Trading in tin has been quiet. The situation shows little change pending developments in Bolivia, where plans for nationalizing the industry have been announced.

Official tin quotations on the London Metal Exchange were:—

Cash—Thursday, £967 to £969; Friday, £968 to £969; Monday, £965 to £965 10s.; Tuesday, £966 10s. to £967 10s.; Wednesday, £967 10s. to £968.

Three Months—Thursday, £955 10s. to £956; Friday, £957 to £957 10s.; Monday, £954 to £954 10s.; Tuesday, £955 10s. to £956 10s.; Wednesday, £955 to £956.

The International Materials Conference has announced allocations for copper, nickel, and cobalt for the fourth quarter of the year. In copper and nickel there is an increase, but cobalt is unchanged from the third quarter. Our fourth quarter share of copper is 101,800 tons, which shows an increase of 1,500 tons over the third quarter's tonnage. In nickel there was an increase from 5,428 tons to 5,473 tons.

The scrap situation does not show much change, for brass scrap prices have continued to decline and the list of maximum quotations no longer has any meaning. In copper, supplies are also improving, but prices have not fallen quite in the same way as brass.

F.&M. FERRO-SILICON★ BRIQUETTES

F. & M. SILICON BRIQUETTES

It is well known that the hardness of ordinary cast iron depends to a large degree on the Silicon content of the metal. Silicon acts as a softening agent in cast iron by its action in reducing the amount of combined carbon, which is liberated in the form of free graphite. The presence of free graphite and a low combined carbon content contribute towards easy machineability.

In these days of restricted supplies of good machinery scrap iron and also of pig irons with a wide range in chemical composition, F. & M. Ferro Silicon Briquettes provide a practical and economical means of increasing the amount of Silicon in a cast iron. The necessary number of Briquettes is added to the charge in the Cupola and all the Silicon contained in the Briquettes passes into the molten metal with only a negligible loss *because the element is protected during its progress through the oxidising zone.*

An important function of **F. & M. Ferro Silicon Briquettes** is in the production of dense iron castings with high tensile strength. The foundryman usually ensures sufficient "softness" in his castings by using a pig iron with 3 to 4 per cent. Silicon. Such pig irons are frequently coarse-grained with large graphite flakes and, when used in ordinary cupola mixtures of pig and scrap iron, are apt to give rise to castings containing large graphitic flakes. This coarse-grained structure, which is particularly developed in the thicker parts of the section, results in an iron of comparatively low tensile strength.

By using pig irons of medium Silicon content (2 to 2·5 per cent. Silicon) which possesses a denser structure owing to their smaller graphite flakes, and increasing the Silicon content of the metal by an appropriate addition of **F. & M. Ferro Silicon Briquettes** to the cupola mixture, an iron with much smaller graphite flakes, and therefore, with a denser structure, is produced. At the same time, the metal is readily machineable, although it is denser and stronger, ***as the composition of the metal remains unaltered from that obtained by the use of higher Silicon coarse-grained pig irons.***

Technical advice for any special working conditions gladly given on request

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★ *We shall discuss our other Briquettes*

SILICOMANGANESE, FERRO MANGANESE AND FERRO CHROMIUM

in later advertisements

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

October 8, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 12s. 6d.; Birmingham, £14 19s.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £49 0s. 8d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £53 10s.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £967 10s. to £968; three months, £955 to £956; settlement, £968.

Zinc.—G.O.B. (foreign) (duty paid), £122; ditto (domestic), £122; "Prime Western," £122; electrolytic, £126; not less than 99.99 per cent., £128.

Lead.—Refined pig-lead: October, £91 5s., to £91 10s.; January, £91 5s. to £91 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £142 15s.; rolled zinc (boiler plates), all English destinations, £140 15s.; zinc oxide (Red Seal), d/d buyers' premises, £148.

Other Metals.—Aluminium, ingots, £157; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £64 10s. to £64 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 27½d. per lb.; rods, drawn, 37½d.; sheets to 10 w.g., 31½d.; wire, 33d.; rolled metal, 30d.

Copper Tubes, etc.—Solid-drawn tubes, 32¾d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £198 to £218; BS. 1400—LG3—1 (86/7/5/2), £218 to £238; BS. 1400—G1—1 (88/10/2), £345 to £375; Admiralty GM (88/10/2), virgin quality, £352 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £355 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 44d. per lb.; sheets to 10 w.g., 46½d.; wire, 49½d.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb. (7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3¾d. to 4s. 4¾d.; to 25 in. wide × .056, 3s. 5¾d. to 4s. 6¾d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9¾d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8¾d.; 15%, 4s. 2d.; 18%, 4s. 6½d. All prices are net.